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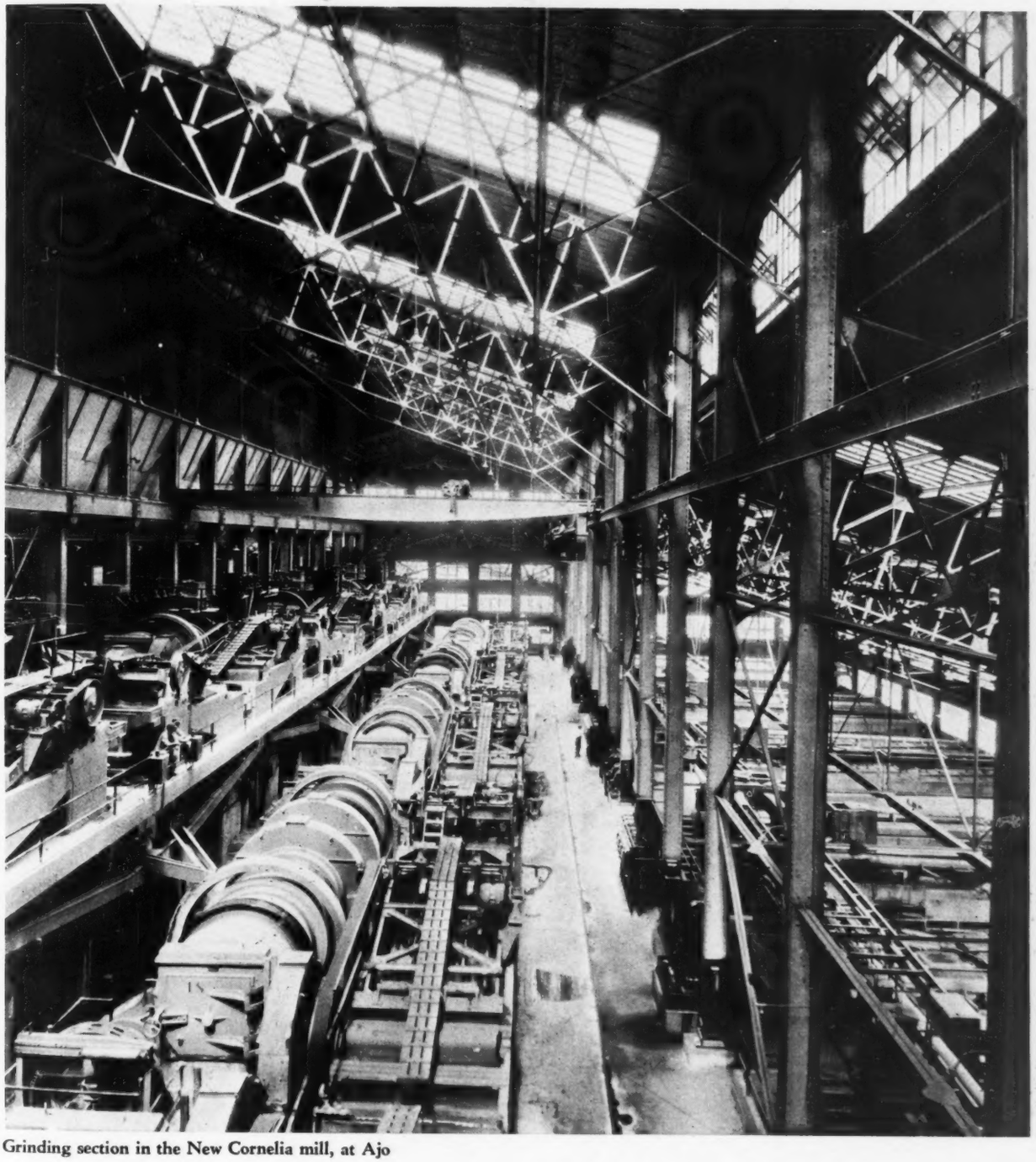

Grinding section in the New Cornelia mill, at Ajo

JUN 23 '30

June 23, 1930

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Contents for June 23, 1930

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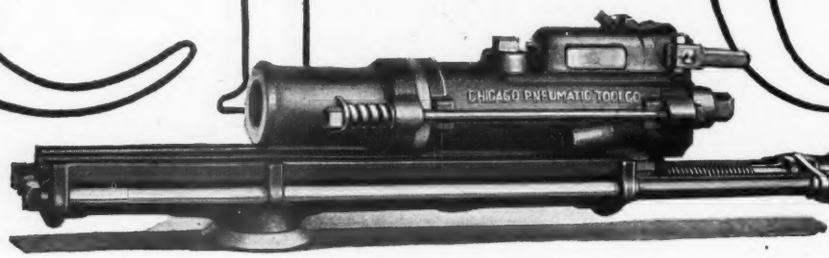

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A Worthy Running Mate for the Time-Tested CP-5

DESIGNED and built for the hardest formations, where drilling speed, dependability and low upkeep are of paramount importance, the CP-6 meets the requirements without the handicap of excess weight.

Similar in appearance and running characteristics, its larger bore, 3½ inches, makes it more suitable than the CP-5 for the severer conditions—low upkeep is a "built-in" quality of both sizes.

Although on the market for a comparatively short period, the CP-6 has been adopted by many of the largest mining companies on the North American continent after extended tests.

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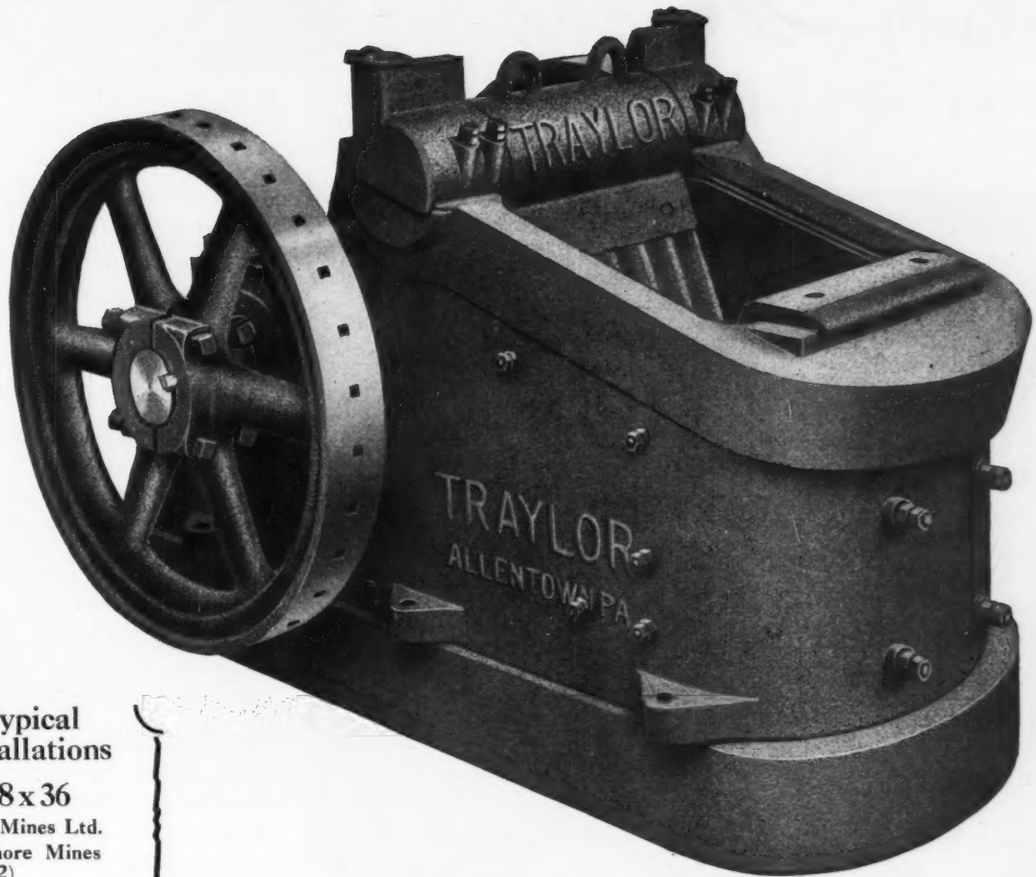

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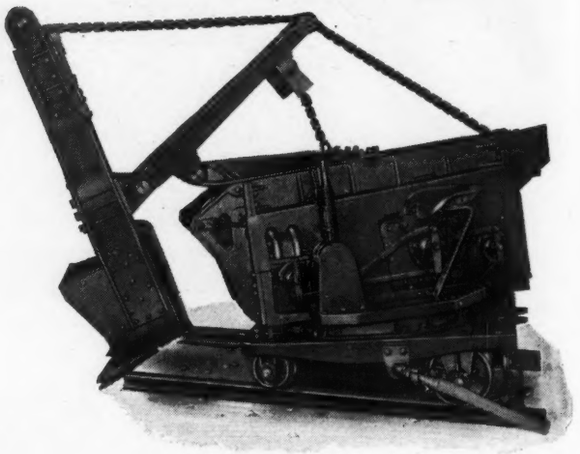
Development Costs go down!



IN reopening a western metal mine, an existing adit four by seven feet in size was enlarged to eight by eight feet. Drilling and blasting was done on two shifts.

On the third shift mucking was done with a Hoar Shovel. Average advance was thirty-five feet per day.

The mucking crew consisted of three men — shovel runner, helper, and motorman.

In addition to mucking the thirty-five foot advance in the eight hour shift, this crew laid new track and extended the pipe lines.

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DEVELOPMENT costs can be reduced, and development speed increased by the use of Hoar Shovels. For twelve years Hoar Shovels have been successfully used in development work in metallic, non-metallic and coal mines; as well as in the more severe work of hydro-electric, water, subway and railway tunnels.

Write for detailed information.

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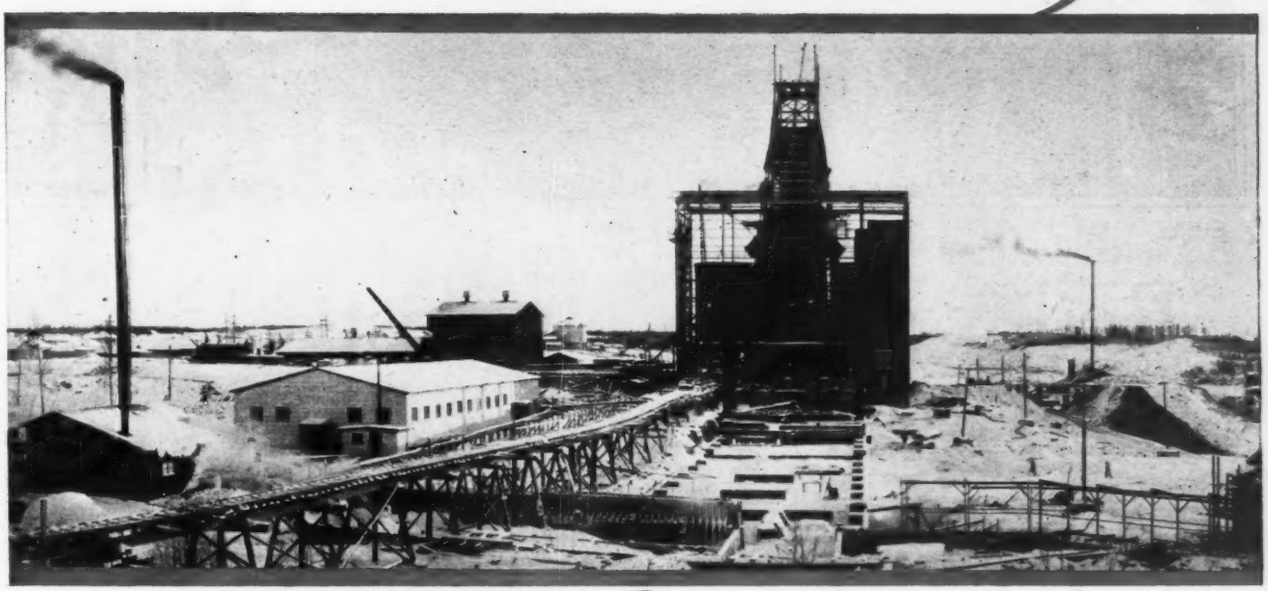
Allis-Chalmers Manufacturing Company, Milwaukee

It is significant that at outstanding properties, where modern methods and equipment are employed,



Flin-Flon is one of the largest mining enterprises in Canada employing 2,300 men in their vast operations. After making exhaustive tests of drill steels Flin-Flon engineers are using Crusca Hollow Drill Steel. They have found breakage is less than 2% and performance outstanding as to cutting qualities and retention of gauge.

they use

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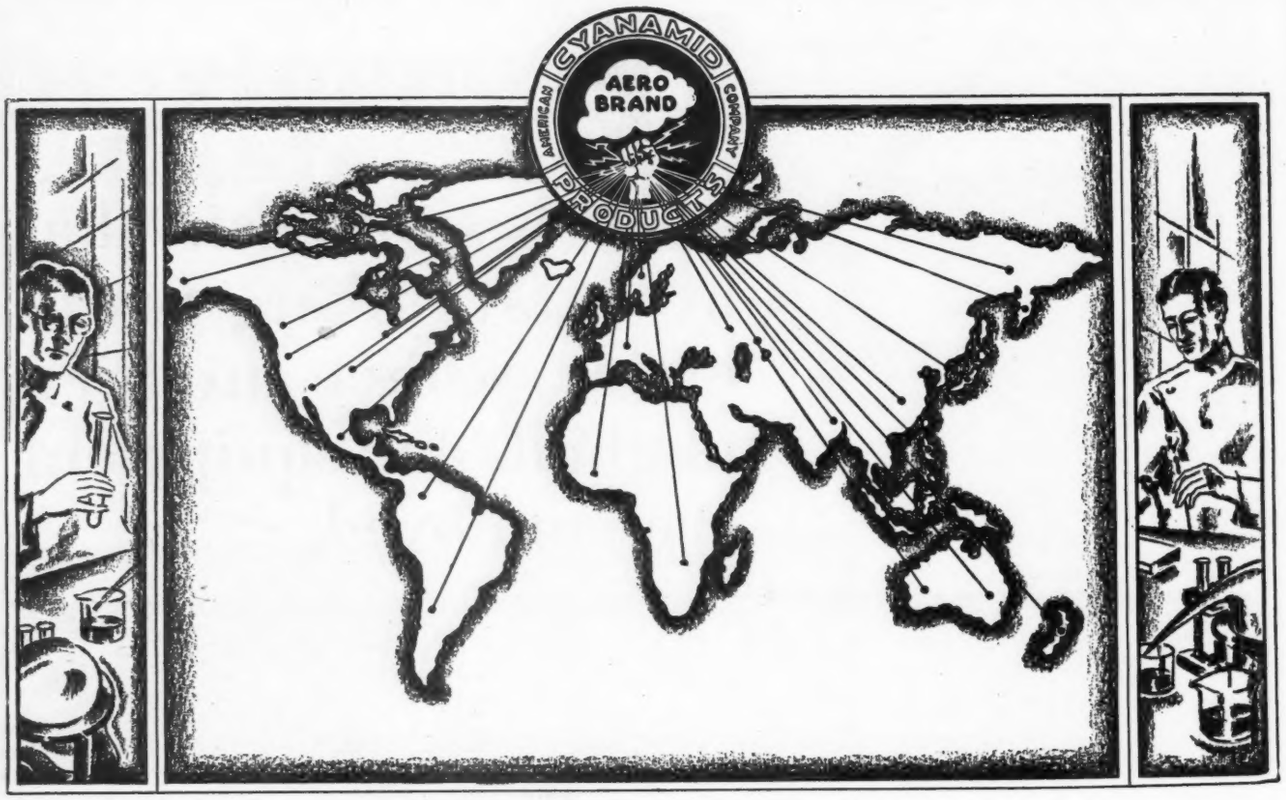

Reduce Flotation Costs This Well-Proved Way . . .

Costly equipment need not be bought in order to effect worth-while savings in milling costs. Many mills have made savings by one of these two simple methods: replacing the old promoter with one of more recent development, or by using a dual promoter system—a combination of different types of promoter.

Further economies accrue when purchases are shipped in combination. There is a saving in freight, in handling, in warehousing and, purchasing itself is simplified.

The American Cyanamid Company, with its complete metallurgical-chemical organization in the field as well as in the research laboratory, is in position to furnish all reagents and to ship them in combination. Full cooperation on any flotation problem is assured.

We shall be pleased to furnish full information on any chemicals used in flotation or cyanidation.

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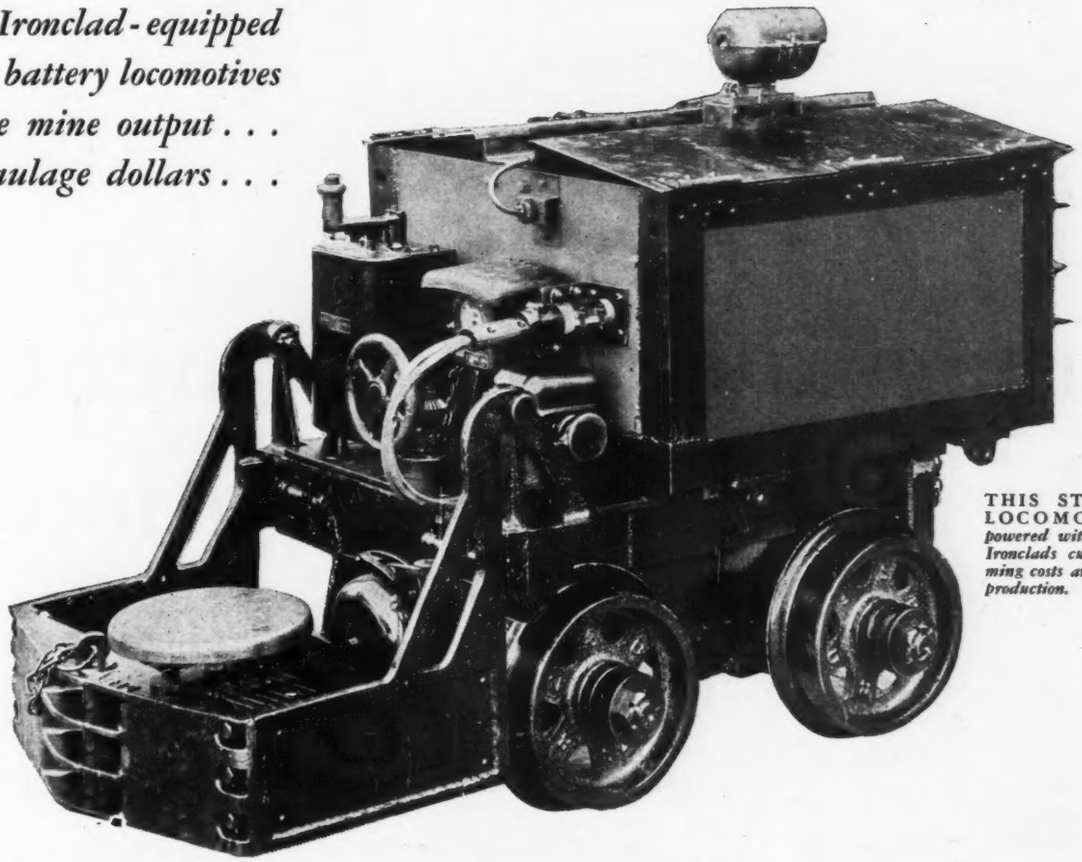
Exide-Ironclad-equipped storage battery locomotives increase mine output . . . save haulage dollars . . .



THIS STURDY LOCOMOTIVE *powered with Exide-Ironclads cuts tramming costs and speeds production.*

SUSTAINED power right up to the end of the shift . . . ability to climb steep grades . . . economical operation day in and day out. That's what storage battery locomotives *must have* to reduce haulage costs . . . build daily tonnage mined. You can make these savings with Exide-Ironclad Batteries as part of your tramming equipment.

These batteries maintain a consistently high voltage . . . are always ready with plenty of reserve power to make the toughest pull. And the unique positive plate construction gives this battery an unusually long, active life. Skilled engineers specially designed the Exide-Ironclad Battery to do the most gruelling tramming jobs with ease . . . to operate dependably and economically under all conditions. And every Exide-Ironclad is backed by the forty-two years' experience of the world's largest battery specialists.

Write NOW, for your free copy of "Facts for Consideration in Selecting a Storage Battery." It contains interesting information that will prove valuable to you. There is no obligation involved.

Exide IRONCLAD BATTERIES

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto

Protect your machinery investment by correct lubrication

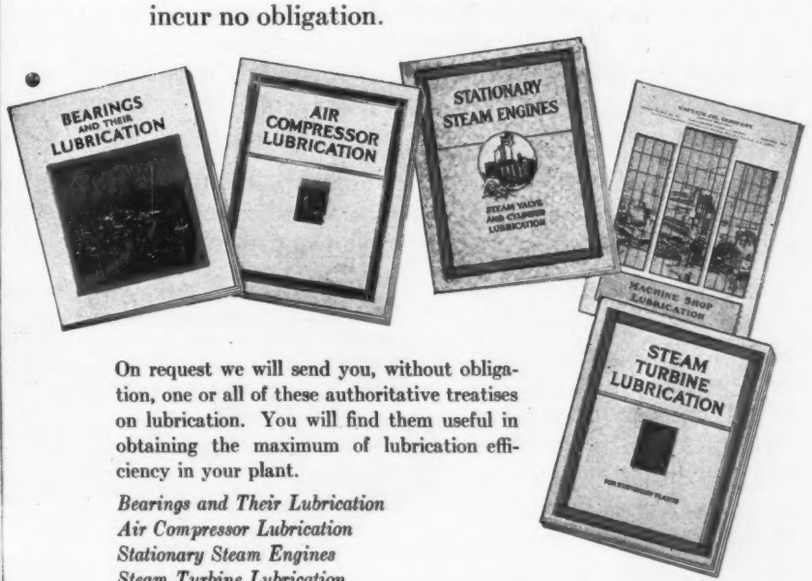
Every year sees an increasing investment in equipment as mining machinery replaces muscle. Correct lubrication therefore becomes continually more important as a means of getting the largest return and lowest depreciation on machinery investment.

MINING engineers and executives who study operating costs, know that every barrel of the right lubricant correctly applied is one of the biggest profit-making employees on the payroll.

And engineers know that the growing multitude of mechanical and engineering problems in modern mining tax their time and versatility to the utmost. That is why the Vacuum Oil Company staff of specialized lubrication engineers, backed by 64 years of experience in lubricating every kind of industrial machinery around the world, are welcomed in mines and factories everywhere.

The whole range of Vacuum lubrication experience is available to help you get maximum machine efficiency —at no extra cost. Thousands of mine and factory engineers have found that Gargoyle lubricants and service enable you to have the best lubrication at an actual profit in operating costs.

Your inquiry for information brings prompt reply from a lubrication specialist in your own field. You incur no obligation.



On request we will send you, without obligation, one or all of these authoritative treatises on lubrication. You will find them useful in obtaining the maximum of lubrication efficiency in your plant.

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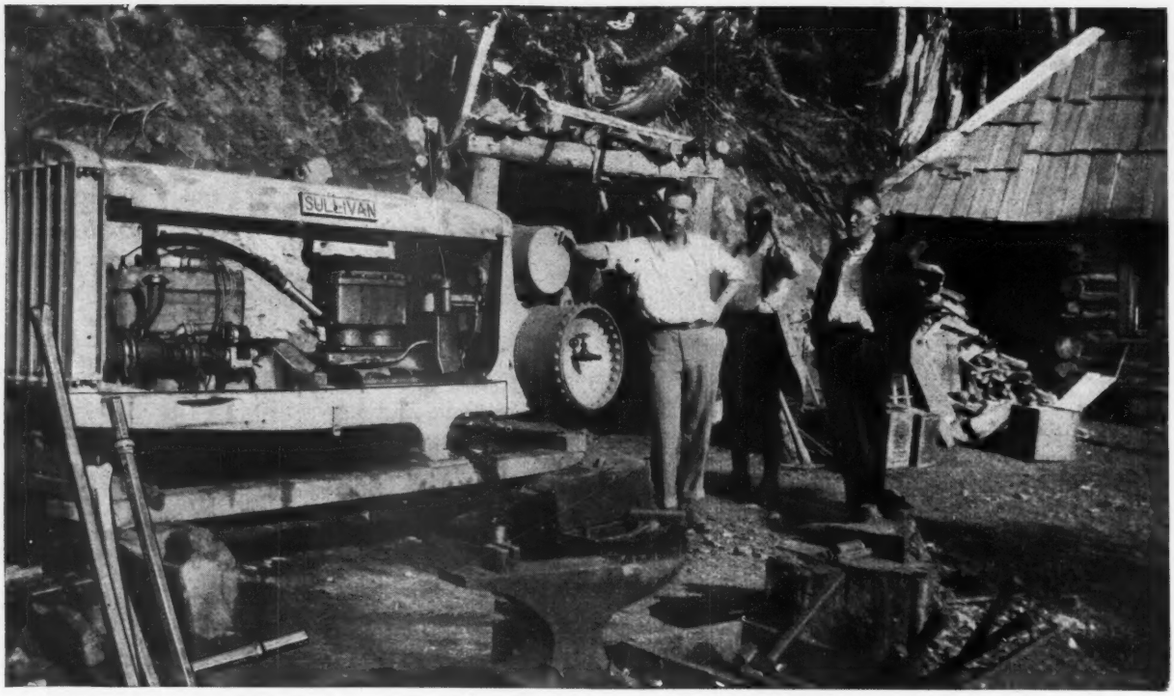


Sullivan "WK-312" Portable used for operating Sullivan Drills and Drill Sharpener, in a mountain region in Washington

Bring Air to the Prospect *Early!*

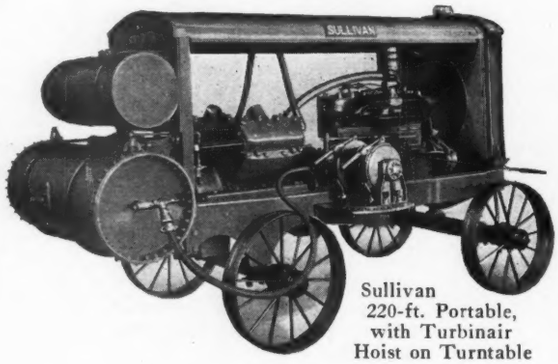
Active working seasons are short on the mining frontier. Hand exploration can accomplish little exploration or development in the time available. But with air power on the job, what a difference!

In a single season, with air, outcrops can be trenched, a shaft sunk, drifts opened, ore shipped, the mine started on the road to profits.

A Sullivan Portable Air Compressor can be taken in to any location, however difficult of access. It will run Sullivan Rock Drills, a Sullivan Drill Sharpener; it will operate a Sullivan Turbinair Hoist to handle timbers, men or muck, or to pull cars.

Sullivan Portable Compressors have been split apart and packed into the mountains on mule back. They have been handled by rail, truck, and boat over 600 miles of Canadian wilderness. They can be handled by airplane if desired.

Sullivan portables are built in sizes from 66 to 310 cu.ft., gasoline engine driven, with steel wheel or rubber tire, or skid mounting.



Sullivan 220-ft. Portable, with Turbinair Hoist on Turntable

There are records of Sullivan Compressors which have run continuously for more than 5000 hours without attention. They are vibrationless.

For prospectors or mining companies in the development stage, Sullivan engineers will be glad to furnish quotations on complete compressed air outfits, with suitable supplies and spares, including portable compressor, rock drills, drill mountings, portable sharpener and oil furnace, Turbinair hoist, drill steel, hose, cable, sheaves, etc.

Ask for new 40-page Portable Compressor Catalog No. 283-R.

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SULLIVAN the Vibrationless COMPRESSOR

It is simply a case of DOLLARS Spent then and Saved now, the use of STOODITE has been responsible for this saving—

Shovel teeth, bucket lips and other parts not only last longer after they have been overlayed with STOODITE—they actually perform better in service.

JOHNSON AND COMPANY
EXCAVATING CONTRACTORS

RECAPITULATION SHEET

NAME OF JOB Gardner Regrade
BRIEF DESCRIPTION Shovel Work and Street Grading
CONTRACT AWARDED 4-6-27
CONTRACT PRICE $32,560.00
WORK STARTED 5-2-27
WORK FINISHED 8-10-27

SUMMARIZED REPORT

	RECEIVED	AMOUNTS PAID OUT
Labor and Fuel		$18,784.56
Supervision and Insurance		5,256.41
Rentals on Equipment		1,864.92
Maintenance and Repairs		**642.67**
Replacements - owned equipment		**1,987.38**
(16 new shovel teeth, one pair bucket lips,etc.)		
Replacements - rented equipment		413.40
Depreciation Charge on Own Equipment		564.36
Total Cost		$29,513.52
Received on contract	$32,560.00	
Extras	301.96	
Total Receipts	$32,861.96	

JOHNSON AND COMPANY
EXCAVATING CONTRACTORS

RECAPITULATION SHEET

NAME OF JOB University Regrade and Excavations
BRIEF DESCRIPTION Drag-line, Skimmer and Shovel
CONTRACT AWARDED 5-2-29
CONTRACT PRICE $64,375.00
WORK STARTED 6-15-29
WORK FINISHED 8-27-29

SUMMARIZED REPORT

	RECEIVED	AMOUNTS PAID OUT
Labor and Fuel		$41,361.87
Supervision and Insurance		6,238.47
Rentals on Equipment		104.37
Maintenance and Repairs		**514.20**
(Including Stoodite and welder's time,		
Replacements -owned equipment		**142.78**
Replacements- rented equipment		1.95
Depreciation Charge on Own Equipment		742.39
Total Cost		$49,103.02
Received on Contract	$64,375.00	
Extras	902.00	
Total Receipts	$65,277.00	

STOODY COMPANY

Manufacturers of

Welding Rod • Alloy Steels • Equipment

WHITTIER, CALIFORNIA

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TAKES DRIVING POWER SO DOES ROCK DRILLING

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That's the Hundred Yard Dash!

Greater driving power in piston-like legs is what sets records in the Century. Greater driving power in the pistons of Cleveland D7 and D9 Drifters is what gives them record breaking drilling speed.

The light weight D7 for one-man drilling even in hard rock. The big D9 for the toughest work a one-man drifter will ever be called upon to do. Try them. We'll be glad to demonstrate.

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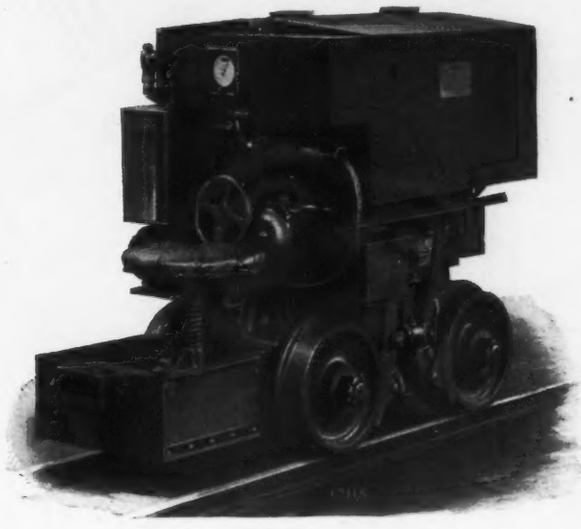
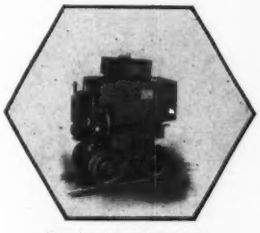
CLEVELAND ROCK DRILLS

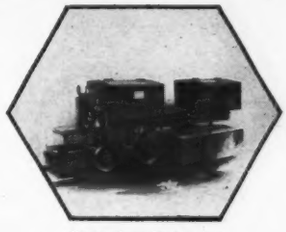
MANAGEABLE

Not Only on the Job but Off





Ready to enter cage.



Changing Batteries

With Trolley and Cable Reel

That this Jeffrey Trammer will go through any tunnel a mine car will—that it takes short radius curves—is easily controlled—is not all you want to know when you consider a locomotive.

You want to know whether it is easy to charge —how it fits in cages—how much repair it needs—and how easy it is to repair it.

With a Jeffrey Trammer can be furnished a swivel battery changer. Just run the dead battery on, turn the swivel, and a fresh battery can be rolled on. This enables you to use the locomotive 24 hours per day if you want to.

To cage the Trammer you merely loosen a couple of bolts—remove the operator's platform, and the Trammer occupies no more space than a mine car. Repair—doesn't need much. But when it does, everything is readily accessible.

In addition the Jeffrey Trammer is packed with power—has brakes, sander, lights, etc., of the best types available. All mechanism protected against water drip and splash.

Where a mine is wired, we build it with trolley and cable reel. Write for descriptive literature.

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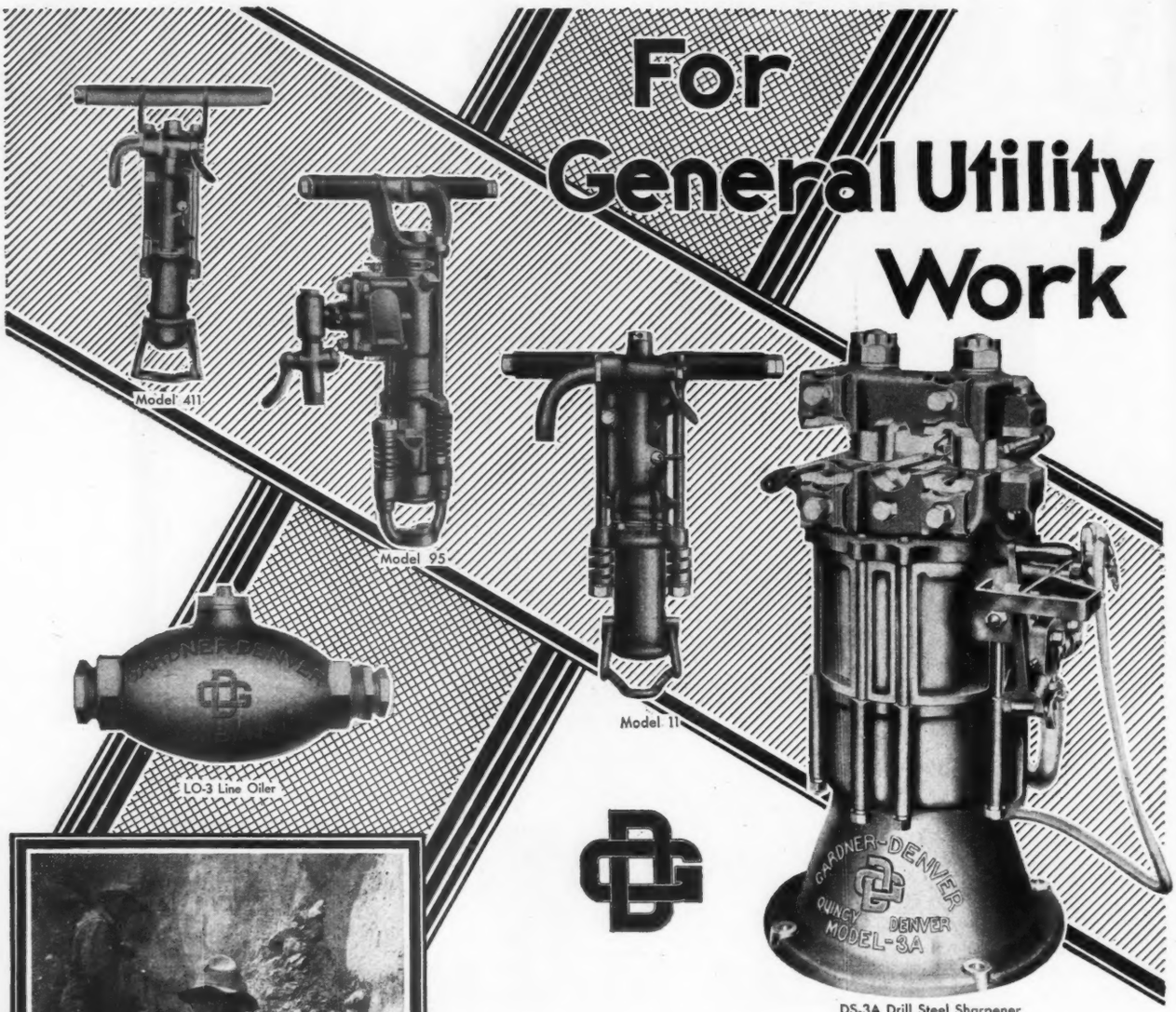
JEFFREY METAL MINE EQUIPMENT

For General Utility Work



DS-3A Drill Steel Sharpener

Gardner-Denver light and medium weight rock drills are admirably suited for general utility work around mines and quarries, they are equipped with easily operated steel pullers, efficient hole cleaning means and with wet or dry attachments. **The LO-3A Line Oiler** is especially designed for efficiently lubricating under all conditions, rock drill equipment of all descriptions. **Gardner-Denver DS-3A Drill Steel Sharpeners** are of medium size, low air consumption and give high speed service on bits up to 2¼" and on shanks on all sections of drill steel. Let our representative call and convince you.

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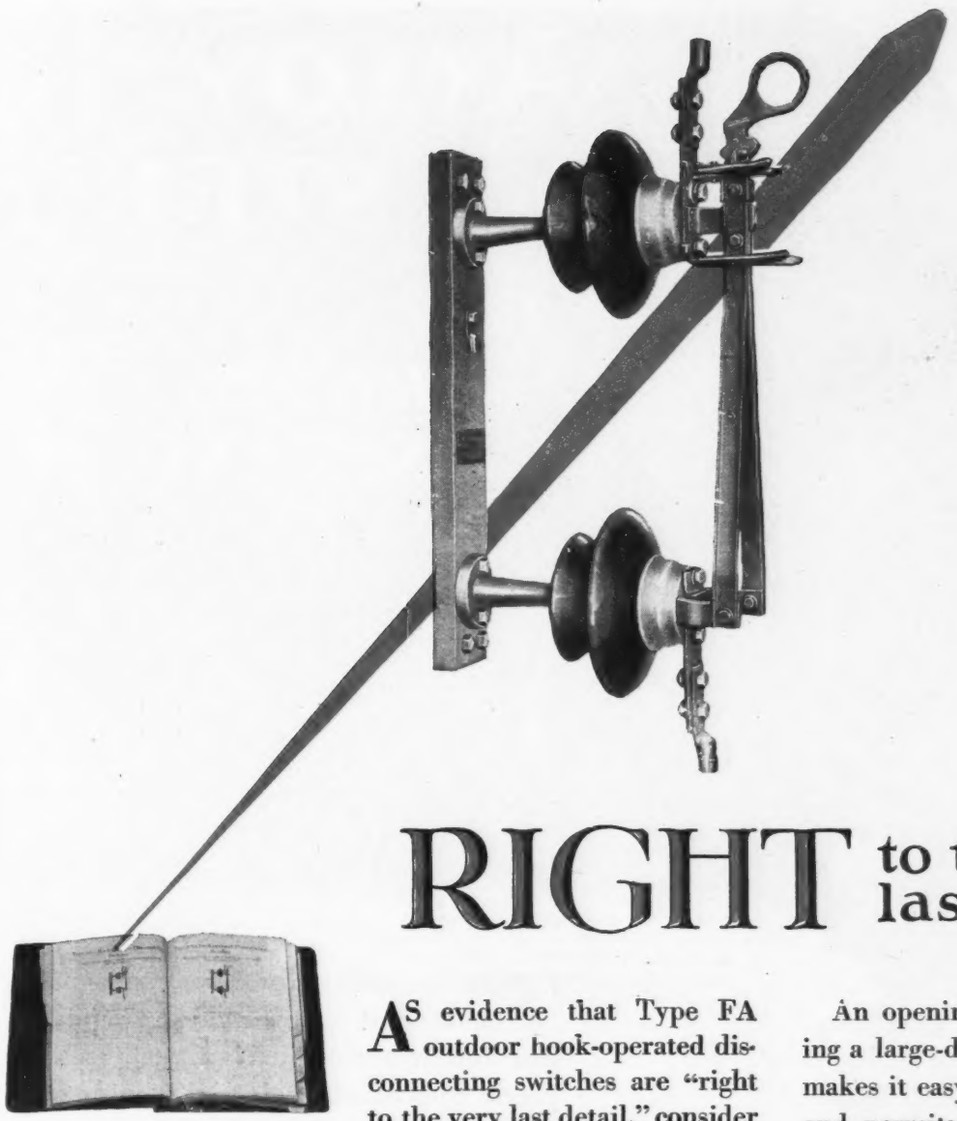

RIGHT to the very last detail

For detailed information, refer to Catalog GEA-1143

AS evidence that Type FA outdoor hook-operated disconnecting switches are "right to the very last detail," consider these important advantages.

A tongue-type contact effects low temperature rise by producing consistently high contact pressure.

The blade, made of two laminations of hard-drawn, channel-shaped, switch copper, is truss-constructed to provide maximum physical characteristics.

A strong, positive, blade latch counteracts any electromagnetic force tending to eject the blade.

An opening device, embodying a large-diameter offset eye, makes it easy to insert the hook and permits operation from a point directly beneath the switch.

A seal-break in the opening device overcomes any sealing-in tendency of the blade.

Large break distances, absence of soldered parts, interchangeable assembled insulator units, and multi-bolt, punched-tube terminals are other features contributing to a correctness of design best described as "right to the very last detail."

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY EVENING ON A NATION-WIDE N.B.C. NETWORK

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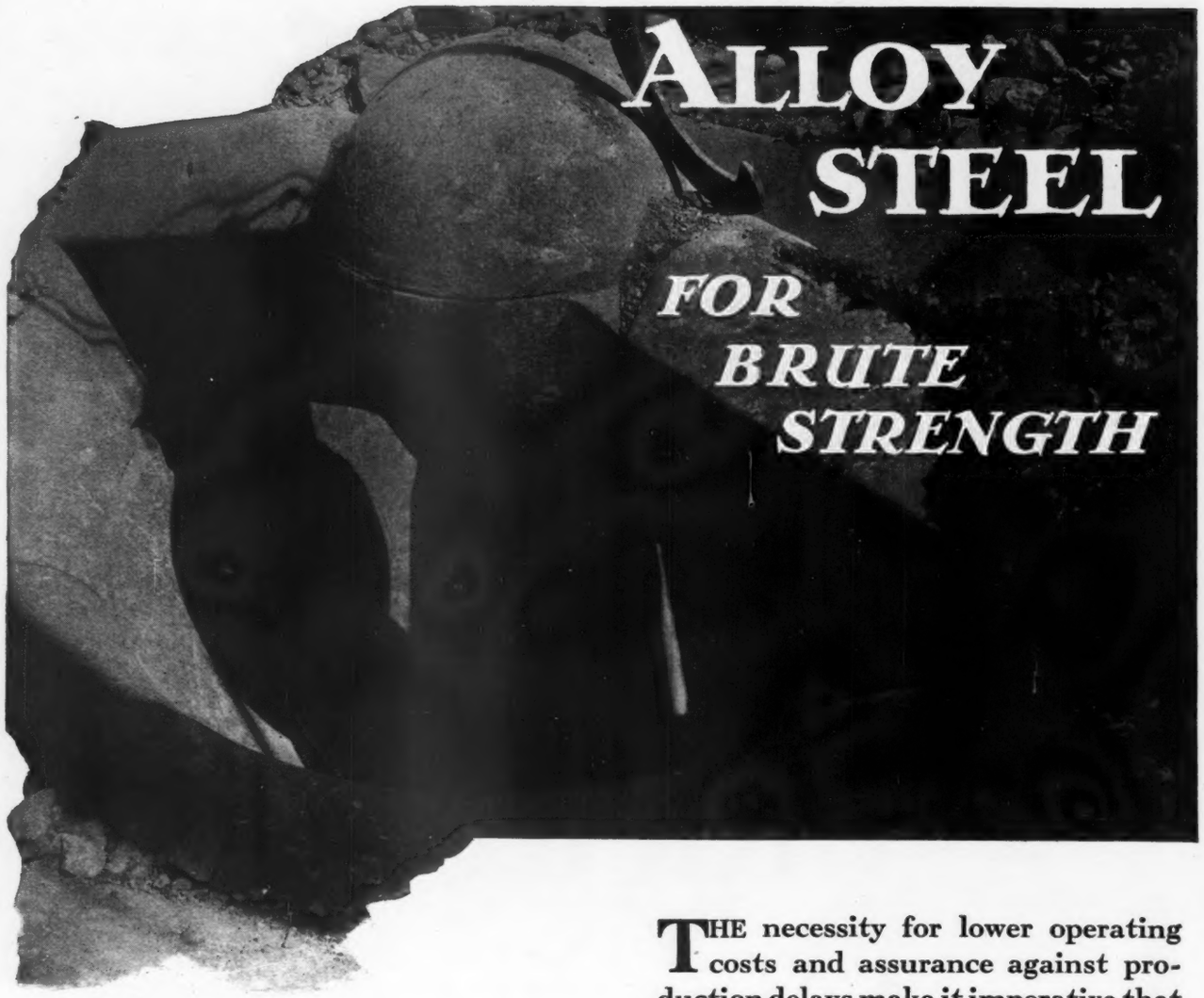

THE necessity for lower operating costs and assurance against production delays make it imperative that plant operators insist on the best in modern machinery practice.

An example of the superiority of alloy steel over plain steel is fully demonstrated by all types of crushers where granite, ganister, trap rock and similar abrasive materials take their yearly toll of mandels, concaves, bearings, crushing heads, discharge spouts and all parts subjected to the wear, strain and impact of these operations.

Alloy Steel has greater strength and affords extraordinary resistance to abrasion, impact, distortion and fatigue—increasing the life of parts and equipment many fold.

Electromet engineers will be pleased to point out the proved economies of Alloy Steel. Write for additional facts of interest.

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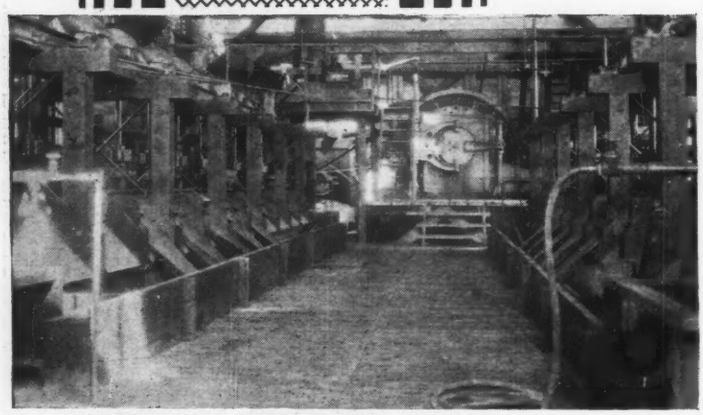

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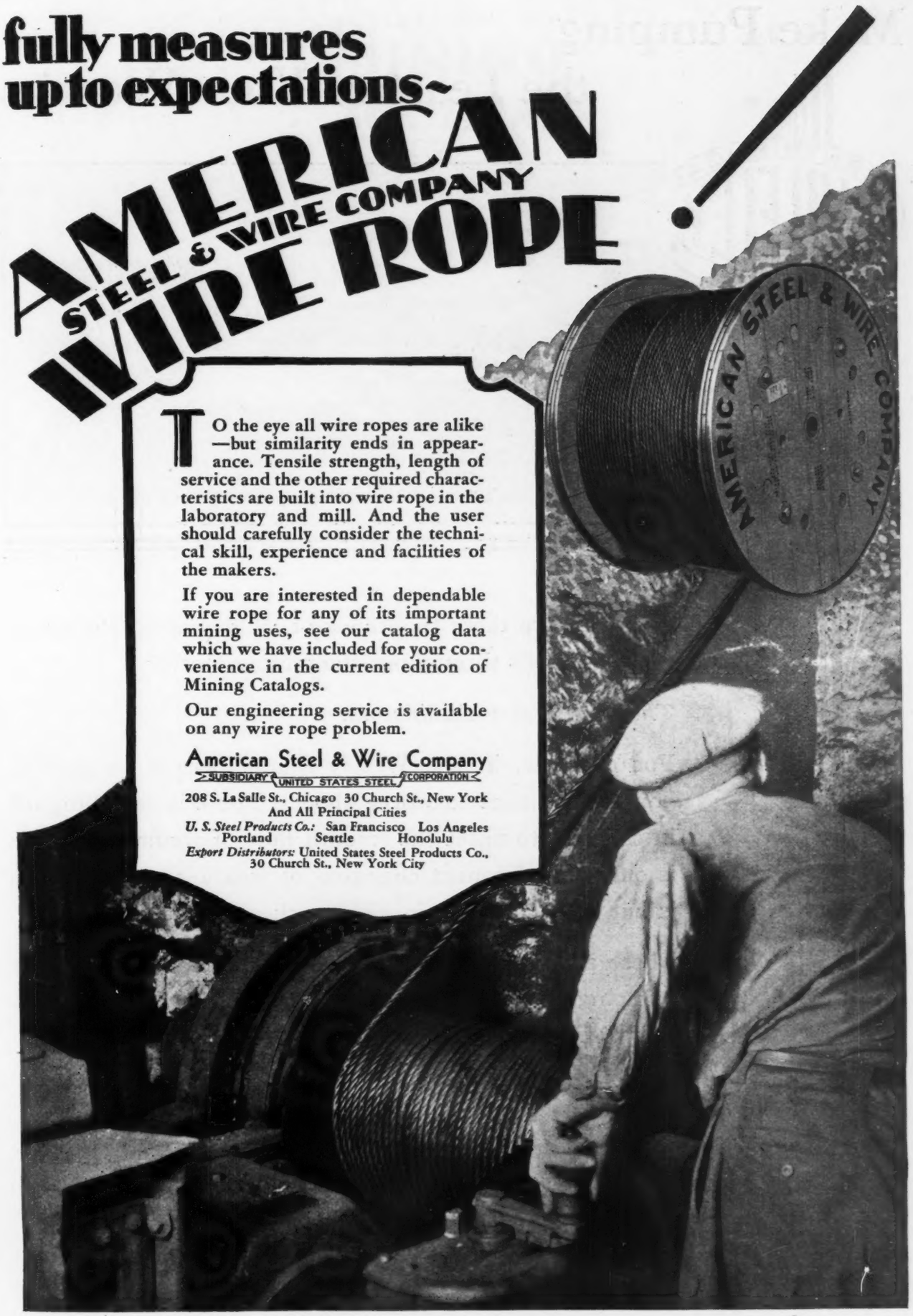

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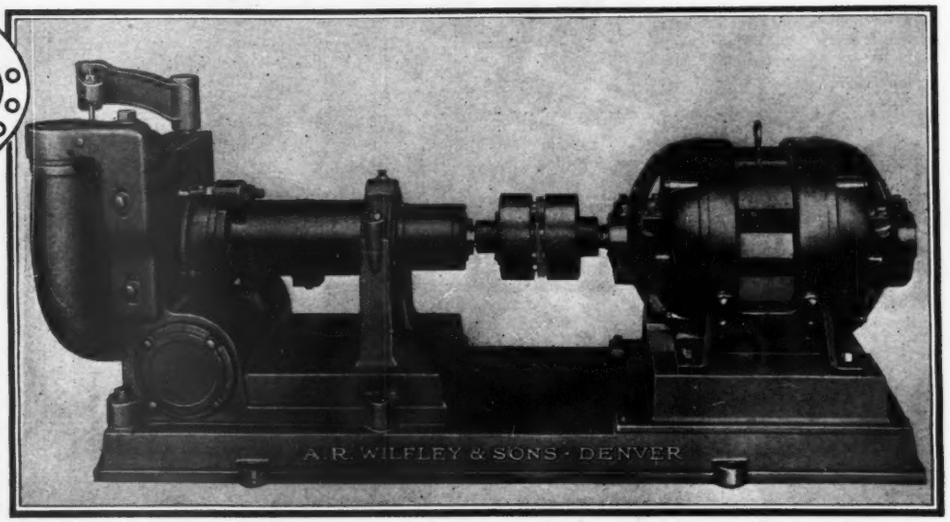

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Morro Velho Pioneers in Conditioning Mine Air

IN our issue of January 14, 1928, we drew attention to the fact that provision for maintaining satisfactory atmospheric conditions underground had to a large extent merely kept pace with necessity. In a small and shallow property, perhaps with a little assistance, Nature provides enough fresh air to enable miners to work reasonably well. With deeper shafts and more extensive lateral workings the need arises for fans to force fresh air where it is needed. But as greater depths have been reached and as temperatures have become higher, and as the realization has grown that the condition of the atmosphere is a vital element in the efficiency of the workers, collectively and individually, elaborate and carefully designed ventilation systems have been introduced. The ventilation engineer has become an important official at every deep mine.

Excellent work has been done on many mining properties in the ventilation of mine workings, and large sums of money have been spent to make conditions as healthful and as comfortable as possible. The changing of air is considered sufficient in most instances where depths do not reach or exceed six thousand feet. Below that distance from the surface the problem may become acute, and special methods must be adopted to combat heat and humidity.

Early in 1928 *Engineering and Mining Journal* published an article by Mr. E. G. Lawford, formerly on the editorial staff, which discussed the operation of air-conditioning plants and outlined some of the problems that would arise in applying the same methods to mine-air treatment. In the editorial to which we have referred, the statement was made that the time had arrived when, in some mines, costs could be reduced by the introduction of modern methods for conditioning air. The immediate need for initiative and research was emphasized, and opportunity was shown for the utilization of an air-conditioning system such as the one now being so widely and successfully adopted in large theaters, hotels, and industrial plants in the United States.

The St. John del Rey Mining Company, operating in the Minas Geraes district of Brazil, has taken the lead, and the first Carrier air conditioning plant was put in operation recently at a depth of nearly six thousand feet in the Morro Velho mine. Incidentally, this property passed its hundredth birthday on April 5, after having handled a record tonnage in March, with a full complement of employees at work. For such progress, and for sponsoring so progressive an innovation in mining engineering, tribute is due to Mr. George Chalmers, general manager of the St. John del Rey company, son of the George Chalmers who for forty-four years played so creditable and important a part in the development of that great property. To Mr. Eric Davies, chief engineer and assistant superintendent of the mine, is due credit for initiative in applying the idea of mine-air conditioning after a visit to the United States, where he inspected industrial plants similarly equipped. Mr. William Hesselman, of the technical staff of the Carrier Engineering Company, was in charge of the construction work in this pioneer effort to apply modern methods and modern equipment to the solution of a difficult problem. A brief description of the plant, in place in the Morro Velho mine, will be found on another page of this issue. The success of the installation, *Engineering and Mining Journal* has confidence in predicting, will stimulate interest and emulation on the part of other companies operating under similar conditions.

The Futile Waste in Friction and Unreason

PRESIDENT HOOVER'S public utterances are usually indicative of an engineer's respect for intellectual rectitude, of the engineer's abhorrence of waste arising from friction and unscientific procedure. Mr. Hoover's professional experience before he became Chief Executive proved that honesty is the best policy in constructive work, and he has always been content to leave to others the perfection of a technique in evasion or camouflage—the stock in trade of the old-time diplomat and the modern politician. Cheap chatter to the contrary notwithstanding, the President's civil record entitles him to be classed as a practical humanitarian; and his contacts with suffering and its causes entitle him to be credited with sincere and honest motives when he speaks "from the heart."

In the hallowed precincts of Gettysburg on Memorial Day Mr. Hoover paid due tribute to Abraham Lincoln. He faced the difficult task that has come to every successor of Lincoln, a task from which any President might be justifiably excused. However, he took occasion to make a call for the exercise of the spirit of charity in every phase of public life; of "the practice of forebearance and the restraint of passion where reason seeks the way"; and he enjoined all "to lay aside blind prejudice and to follow knowledge. . . . "

The advice seemed sound, yet it failed to register approbation from the New York *Times*. "Democracies cannot be carried on in that way," it maintains. "For them the rough and tumble manner; the hurling of the epithet and the lie; the invention of myths; the exploitation of passion; the whipping up of prejudices. Yet all

this goes on with the half-wink and the exaggeration which is one form of our humor. . . . If we were all reasonable, charitable, tolerant, unprejudiced, how could there be any parties," continues this critical daily; "how many of us would take the trouble to vote in a community blessed with a majority of savant-saints."

The possible hazard is too slight to be recognized. The problem lies more in expecting the average person to see anything justifiable, much less funny, in what is patently reprehensible. A wide gulf yawns between the saint and the average politician who stoops to practice what the *Times* interprets as evidence of a national sense of humor. An equally wide gulf exists between the savant and the nit-wit, whose mental condition is only aggravated by the truth.

Alertness, as Well as Fitness, a Qualification for Survival

SIX YEARS AGO a certain person bought a machine of good design, sold at a fair price, made by a new, unknown, but apparently progressive, company. The consumer was well satisfied. In time, however, the heating element—an essential part—burned out, as even the best of heating elements will, and a new one was needed. Unfortunately, however, the dealer from whom the machine had been purchased no longer carried that line, and inquiry developed the fact that the manufacturer had gone out of business. The desired element was worth, perhaps, a third of the total cost of the machine; to have one built specially was out of the question because of the expense. Repair was impracticable, so the machine—most of it as good as new—had to be scrapped.

The incident related in the foregoing paragraph was called to mind by the receipt of an attractive booklet, issued by a leading manufacturing organization, entitled "Beginning the Second Century." In 1830 Thaddeus Fairbanks, at St. Johnsbury, Vermont, began building the platform scales he had invented. Charles Hosmer Morse was an apprentice in the factory, later going to the Chicago agency. Morse found that the world needed good windmills and steam engines, as well as scales, and so a factory to build them was erected at Beloit, Wisconsin. Later on, steam was found not always to be the best motive power, so gas engines and Diesel engines were manufactured there; and for those who wanted to use electricity, another factory, producing the first ball-bearing electric motors, came into being in Indianapolis. Another branch has specialized in the manufacture of a broad range of pumps for industrial use. Knitting all these units together, for the benefit of the consumer as well as to promote manufacturing efficiency, is the engineering service of the Fairbanks-Morse organization, which so many in the mining field, as in other branches of industry, have come to know.

To go back to the incident first related: surely no one need hesitate about the permanence of a company that is embarking with undiminished vigor on its second century; or consider the possibility that it will sacrifice a reputation for honor and integrity based on a hundred years of effort. A familiar radio story relates that in the city of Bagdad lived Hakeem, the Wise One, and many people went to him for counsel, which he gave freely to all, asking nothing in return. Then came to him a young man who had spent much but got little, and said: "Tell me, Wise One, what shall I do to receive the most for that which I spend?" Hakeem answered: "A thing that is bought or sold has no value unless it contains that which cannot be bought or sold. Look for the Priceless Ingredient." "But, what is this Priceless Ingredient?" asked the young man. Spoke then the Wise One: "My son, the Priceless Ingredient of every product in the marketplace is the Honor and Integrity of him who makes it. Consider his name before you buy."

Many industrial firms are justly proud of the honor and integrity that has played so important a part in their success. Some, like the company mentioned, have records that indicate mature experience as well as aggressive purpose. Others, younger but no less steadfast in purpose, are striving to emulate them. To such can the advice be given: "Plan so that you never sacrifice public good will. Remember the value of cordial human relationships. Put character into what you make. Inject the priceless ingredients, into your product."

Zinc Production and National Aspirations

ANNOUNCEMENT from Melbourne, that three of the leading Broken Hill companies have signed a contract for the disposal of zinc-concentrate output after June 30, ends the speculation caused by the impending expiration of the Board of Trade contracts now in force. During the World War, Great Britain urgently needed a steady supply of zinc from within the Empire, and Australia was then the most important zinc-ore producer among the colonies. The Board of Trade contracts were made with the leading Australian producers to insure this supply. They provided for aid whenever the price of zinc fell below £30 per long ton in the London market.

Cost of production in Australia has increased since the War and the price of zinc has steadily declined. Without the help of the contracts the Broken Hill companies probably would not have been able to produce zinc profitably within the last few years. Zinc is now selling below £17, and an early marked improvement can hardly be expected. The approaching termination of the contracts was therefore viewed with apprehension, which the new agreement should dispel. Electrolytic Zinc of Australasia and Imperial Smelting are the two companies that have contracted to purchase the Broken Hill output, no doubt at terms that are higher than the present market. The latter concern, formed last year, represents a large group of British mining and metallurgical interests that desires to maintain and strengthen the Empire's base-metal industries.

Other indications that national consciousness has been aroused in the field of zinc production are available. German producers have steadfastly refused to curtail production further, on the grounds that Germany has changed from a zinc exporter to a zinc importer, and that, with local plant capacity available, no valid reason exists for increasing the proportion of imports—a step which additional curtailment would necessitate. To protect the domestic industry in Germany, a tariff on metallic zinc may be levied.

The significance of these moves is obvious. World-wide depression now obtains; zinc is one of the commodities hardest hit. Each nation is concerned, naturally and necessarily, with employment problems within its own borders. Without subsidies, cartels, or tariffs, production would become concentrated among the low-cost mines, many of which are situated in exporting countries. Erection of artificial barriers by leading zinc-consuming countries, in the hope of becoming self-sufficient, narrows the market for such countries as Belgium, Poland, and Mexico, which produce more zinc —as ore or metal—than they consume. Their resources will be utilized eventually. Zinc reserves are not inexhaustible. Meanwhile, producers will have to bear patiently with the inequalities of a world comprised of selfish entities.

Cost Standards and the Personal Element

INSISTENT is the demand for cost statements, particularly in regard to mining and metallurgical operations. But the inquisitive should be warned that the following of a lead and the duplication of plant and process are not alone necessary to duplicate results. On the other hand, many a noteworthy process has been denied recognition because of the ease with which it could be maltreated by those who disdain frugality and see no connection between simplicity and efficiency.

An example: The initial commercial application of hydrometallurgical methods for the recovery of nitrate from *caliche* in Chile permitted the removal of steam pipes from the interior of the leaching vat, and in consequence, its effective insulation, because of the ability to discharge residue by mechanical means, from above. The opportunities for fuel reduction were obvious, but they were ignored in the initial application of the process. The old small-unit leaching vats were used, perched high above the ground, and exposed, uninsulated, to the lowest temperatures experienced on the nitrate pampa. The heat in the final solutions was dissipated into the atmosphere, in a determination to utilize crude and inefficient crystallization pans already on the property, the final result being a fuel consumption that was unjustified. On the sole ground of excessive fuel consumption the new innovation was condemned by one nitrate "expert," whose hasty judgment on the cost of operation considered solely a method of application that was parsimonious in initial expenditure and wasteful in operating requirement in respect to fuel.

Costs mean nothing unless the personal inclinations of those in control of operations are taken into account. A high cost may serve to discredit a highly useful and practicable technical process. A low cost may indicate a fortunate combination of experience and zeal in preliminary planning as well as in subsequent operation. Even the most efficient plans can go awry when no incentive exists to translate them into economical practice; so the inexperienced imitator may fail to duplicate the results obtained elsewhere after many years of trial and discard. Good machinery and logical flow sheets are essential to success, but equally necessary is a directing mind with an understanding and a co-operative spirit.

Opportunity Remains for Fundamental Research

THE commercialization of the spirit of research proceeds apace, which is not to be deprecated altogether, because science needs the injection of more business, and without business direction the research program is unlikely to prove an attractive investment for capital. On the other hand, the tendency is becoming common to entrust research to those of immature judgment, who merely possess a highly successful scholastic and academic record, often indicating merely the possession of a dogged perseverance and a retentive memory. Scientists in this class are clannish, having little sympathy for the type of worker who laid the foundation of present-day achievement.

The day is not past for the practical man with the inventive urge, who knows what is wrong with present methods and shapes his course in the direction of useful achievement, usually not being blessed with the resources that would permit enjoyable excursions into the obviously impracticable. Although inventions of importance will continue to be made on the existing structure of complex specialization, opportunity still exists for those who are not unwilling to delve into simple fundamentals, who realize the scope for the application of intelligent thought and common-sense deduction to every-day problems.

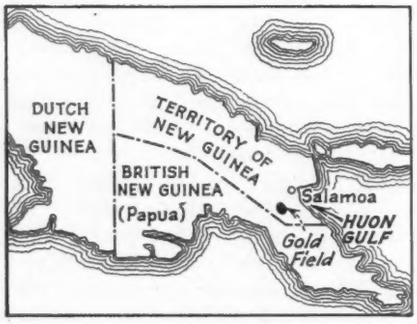
An example of simple reasoning in the solution of a heat-transfer problem comes from Alaska, where an operator of a steamboat on the Yukon River chafed each year at the delay caused by the slowness with which the Alaskan sun melted the ice, as summer approached, and permitted the resumption of work. The problem was to speed the melting and the release of the boat, in winter quarters on Lake La Barge. The owner, Captain H. Wheeler, is reported to have made possible the resumption of sailings a month earlier than usual by realizing the possibilities of such tools as lay at hand. The sun's rays carried the necessary heat, but the ice reflected more than it absorbed. Melting would be hastened if the heat could be retained, and to do this the captain evolved an inexpensive scheme. On the ice, therefore, he painted, with a mixure of lamp black and refuse oil, a ribbon forty feet wide and some miles long, which, absorbing the heat from the sun's rays, promptly melted the ice and so cut a channel for the ship.

In this instance the simple application of common sense and elementary reasoning, too often disdained by the scientific research worker, resulted in an invention of far greater value than most of the notions and modifications that clutter the patent office. The idea had a modest beginning, involving a type of research—constructive thought—that necessitated no financial expenditure. The first application of the heat-absorbing mixture was made by hand, using brooms, but the success of the invention will justify the purchase of power tractors, which will be operated in conjunction with mechanical sprayers.

From such simple beginnings spring methods and practices that have a profound effect on technology and engineering. The lesson to be learned is that more attention might well be paid to simple fundamentals, which are likely to be ignored in the haste to improve what others have invented. A research worker with an intelligent ignorance of his subject is likely to produce results quicker than the one whose natural gift of creative thinking has been dulled into insensibility by the very weight of data he has accumulated by study.

A G31 Junkers plane in the air. This is the model that will be used to transport dredges to the gold field.

AIR TRANSPORT



Sketch map showing the situation of the New Guinea gold field

Aids Mining in New Guinea

THE recent incorporation in British Columbia of Bulolo Gold Dredging, Ltd. (a subsidiary of Placer Development), with a capital of $4,000,000, marks the first stage in the development of what may prove to be one of the world's richest alluvial gold fields —in New Guinea. It forecasts the engineer's conquest of natural difficulties, rarely associated with a mining enterprise, formerly considered insurmountable. To reach this stage, the airplane has already proved invaluable. Planes have been used for nearly three years to provide regular passenger service from the coast to the field, reducing the time of travel from seven days, along an indistinct foot track over mountainous country, to 40 minutes under satisfactory flying conditions. Airplanes have also been adopted in New Guinea, as in other countries, for aërial surveying, prospecting, general reconnoitering, and the transport of freight on a limited scale.

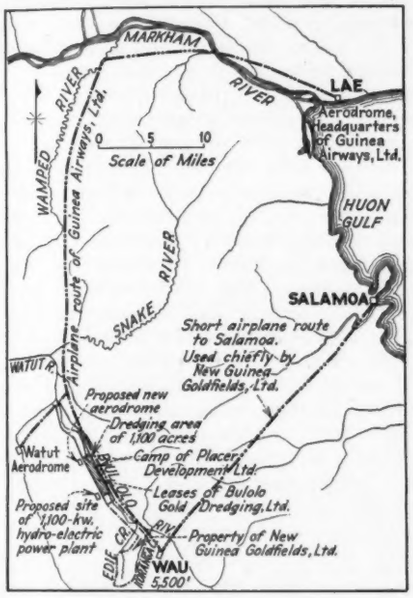
The property of Bulolo Gold Dredging is being brought to production by the use of airplanes as the sole means of transporting 2,500 tons of equipment and material for two large electrically operated dredges and for a 1,100-kw. hydro-electric power plant. Moreover, all construction materials, stores, and food supplies will be so transported. Later, airplanes are to be adopted as the permanent means of transport and communication. The company thus pays a wonderful tribute to the safety and dependability of modern air craft, and demonstrates that such equipment is an important aid in developing an isolated mining property, with a minimum of capital expenditure, in the shortest possible time. Construction of a 90-mile road to the field would cost more than $1,250,000, and would delay production for at least two years. Furthermore, when completed the maintenance cost of the road would be unusually high.

New Guinea's alluvial gold field that

Salamoa—main port of call in eastern New Guinea for steamers from Australia. A motor launch connects with the aërodrome at Lae.

This article by our special Australian correspondent is based on information obtained from several mining engineers who returned recently from the New Guinea gold field.

will be dredged by the Bulolo company is 37 miles direct from the port of Salamoa, and is at an elevation of 2,200 ft. above sea level. An altitude of 9,000 ft., however, is reached by the intervening mountains. The property, which begins at the mouth of a gorge below the junction of the rich Edie and Koranga creeks, is the initial catchment area for the auriferous erosion material carried down by these creeks. For such a topographically rugged country, the ground surface is remarkably level. The bedrock upon which



Sketch map of the New Guinea gold field, showing air transport routes

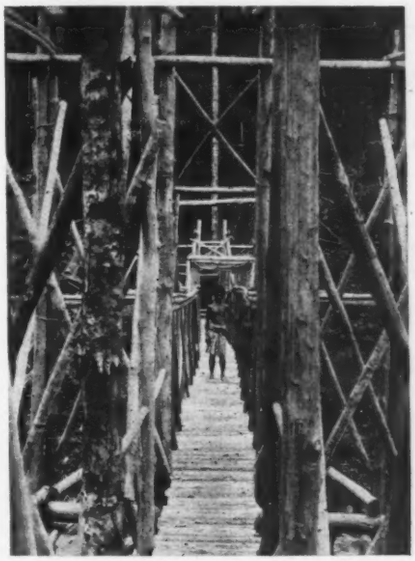
the dredgable alluvial wash rests is felsite, now decomposed to a soft blue clay.

The area is divisible into two sections—the important southern or upper flat, and the lower-grade northern flat, situated near the junction of the Bulolo and Watut rivers. Both flats, which are separated by a gorge, are covered with dense tropical jungle. The wash in the southern flat, which is described as a basin deposit, shows a tendency at the upper end to become heavy with a considerable amount of clay. Neither the large stones nor the clay constitute a serious dredging difficulty, particularly in view of the success of the large Malayan tin dredges in dealing with similar wash. The northern flats, considered too low-grade for mining at present, have not been sampled extensively.

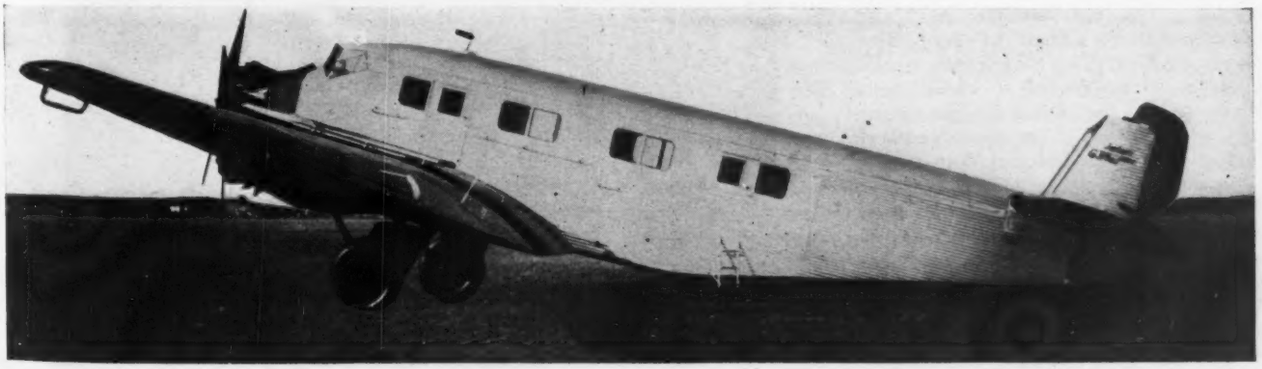
Settlement at Wau. The building on the left is the hotel, and on the extreme right is shown the general store.

The southern flat was bored with Ward-type hand drills, 4-in. casing being employed. Additional sampling involved shaft sinking. Initially, the lines of drill holes were spaced 1,320 ft. apart, the holes in the lines being at 166-ft. centers. This close spacing was decided upon because the ground was expected to contain high-grade "pay" channels. However, when the gold was found to be evenly distributed, the distance between the lines was increased, and the number of holes per line decreased. In proving the southern area, a total of 104 drill holes and six shafts were put down. Dredging depth was found to be 21.9 ft., which, with an area of 1,102½ acres, gives a total of about 39,000,000 cu.yd. The estimated average recoverable value of this wash, taking the gold as worth $13.65 per oz., is 50.5c. per cubic yard. The total area of the leases held by Bulolo Gold Dredging is 2,000 acres.

Plans have been perfected to equip the property with two steel-hulled, 10-cu.ft.-bucket dredges that jointly will dig 3,500,000 cu.yd. per year, yielding a gross return of $1,700,000. With this yardage, the property, as at present proved, will have a life of twelve years. Electric power will be provided by a 1,100-kw. hydro-electric plant to be installed at the southern extremity of the property. The company has acquired water rights for 700 sec.-ft. of water, and will construct a diversion weir across the river, with a water race 1¼ miles long to the headworks of the power station. The estimated cost of the two dredges, workshops, hydro-electric power plant, camp, and including contingencies is $2,136,000, or about 19c. per cubic yard of wash. Dredging costs will not exceed 15c. per cubic yard, but,



A foot bridge across the Bulolo River near the leases of Bulolo Gold Dredging, designed and erected by a mining engineer



The Junkers G31 plane on the ground. The cabin will be altered to provide additional space for freight

Typical New Guinea alluvial gold field scene near Edie Creek. A water race for sluicing that carries water from a creek higher up is shown traversing the alluvial workings.

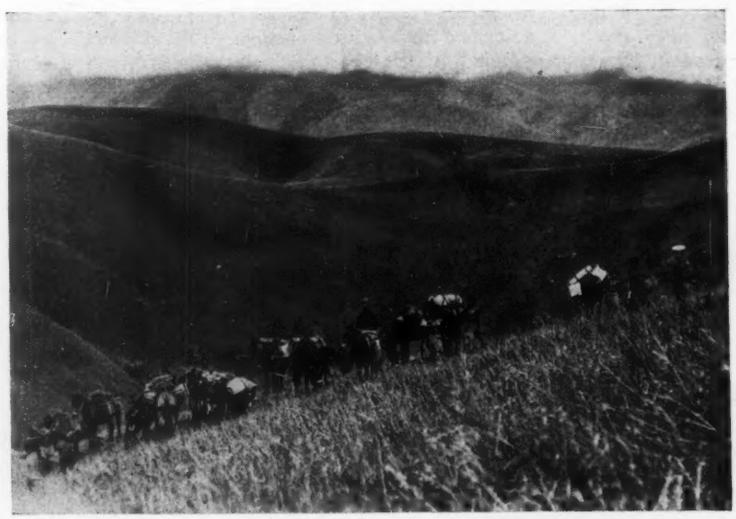
inasmuch as this figure is almost double that of well-equipped dredging companies in Malaya, a material reduction in these costs will probably be effected as dredging proceeds.

In the early prospecting period, suitable transport facilities were lacking. To remedy the situation, with a minimum expenditure, C. L. Levien, who had been associated with New Guinea gold mining for some years, formed, in 1926, Guinea Airways, Ltd. This company alone has made possible the rapid development of New Guinea's wealth, and has provided the only effective means of transport between the coast and the gold fields. The accompanying sketch map of the area, which is based on a map prepared by J. C. Coldham, shows the coastal aërodrome at Lae, 17 miles from Salamoa. Passengers and stores are landed at Salamoa and taken by motor launch to the Lae aërodrome in about four hours. The route of the airplanes from Lae to the gold field is shown on the map. About 40 minutes is required for the trip, during which emergency aërodromes are passed at frequent intervals. Because of the height of the intervening ranges, the altitude of flying is abnormal, and fogs and clouds resulting from a wet climate make flying conditions difficult at times. The planes land at Wau on a gentle uphill slope at right angles to the Bulolo River, so that the takeoff for the return trip is down hill. In good weather, four trips between Lae and Wau can be made per day.

The three planes that have been used by Guinea Airways are single-engined, all-metal Junkers monoplanes equipped with Bristol-Jupiter engines. When fully loaded, this type of machine will carry 1,900 lb. The freight rate is 18c. per pound, and the passenger fare $50 per return-trip journey. The company has a remarkable record for safe transport. Since operations were begun on Dec. 1, 1927, to Jan. 31, 1930—26 months—1,769 business flights were made; 2,792 passengers, including 801 natives, were carried without mishap, as well as 1,320 tons of cargo. In December, 1929, and January, 1930, the company carried 230 tons of cargo. Throughout the period of its operations the company has made regular reductions in freight charges every six months, and today the rates are half what they were at the beginning.

At the instigation of Bulolo Gold Dredging, Guinea Airways is now making arrangements to operate two specially designed Junkers freight machines to transport the aforesaid 2,500 tons of dredge material and other equipment to the field. The sponsors of this proposal were Captain E. Mustard, late chief pilot for Guinea Airways, and Major E. Berryman, Australian representative of the Junkers company. In developing the idea, a model of the plane and models of the castings to be carried were made, which demonstrated the possibility of transporting in the airplanes all the equipment, including castings of 3½ tons' maximum weight. The machines to be used will be Type G31 Junkers monoplanes, equipped with three air-cooled Bristol-Jupiter engines. Each engine will develop 450 hp., and the plane will have a speed at full load of 115 m.p.h. Sufficient fuel for three hours' flight at this speed will be carried. In the all-metal construction of the plane, duralumin and sheet steel will be used for struts and for parts not exposed to particular stress; for pieces of unusual shape, electron and silumin will be employed. Such construction will obviate the need for building hangars, as well as increasing the safety of the airplanes. Only an engine cover will be required, which will greatly reduce depreciation and maintenance. The machines are expected to have a life of twelve years. The approximate dimensions of the planes will be: Span, 100 ft.; length, 56 ft.; wing area, 1,100 sq.ft.; height, 19 ft. To accommodate the large castings and to enable the maximum amount of freight to be carried per trip, alterations are to be made to the normal passenger machine whereby extra freight space will be made available.

This extended use of the modern airplane in mining development will be watched with interest, especially in many countries where capital outlay to obtain adequate transport facilities and the time required to provide such are serious deterrents to the equipping of a property. Once again, mining, because of its inherent complexity, is one of the first industries to accept and apply with advantage the advances made in other branches of engineering.



Bringing in the first mules from Salamoa to Wau for the transport of supplies from Wau to the field

Undercut Caving

George J. Young
Associate Editor, San Francisco

UNDERCUT CAVING is one of the most fascinating of the mining methods. Evolved from relatively primitive caving methods, and necessarily restricted in its application to certain situations and to certain types of orebodies, the present practice represents cumulative experience in mining rather than analysis of the mechanics of rock masses. Many, myself included, have taken a fling at this obscure subject—the mechanics of rock masses—but the deductions and speculations that have resulted are not satisfactory, although, doubtless, they have helped. Recently, F. W. Maclennan discussed in considerable detail the undercut caving methods of the Miami Copper Company, and his disclosures can be used as a basis for the presentation of an analysis of some of the important principles involved.

MACLENNAN states that in the earliest caving methods at Miami the entire width of the orebody was undercut and caved, beginning at one end and retreating along the length of the orebody, closely followed by ore drawing, a contact plane between broken ore and waste rock being maintained at from 40- to 60-deg. slope. The width of 500 to 600 ft. resulted in excessive weight upon extraction openings. Later experience indicated a width of 150 ft. in alternate panels, and this served for comparatively low lifts, but the opinion was held that the practice would not be satisfactory for a high lift, 300 ft. or more. In retreating along a panel, an ore column of 300 ft. would necessitate a length of some 300 ft. of extraction level, open and in good condition, and it was considered that excessive weight under the circumstances would interfere with systematic ore drawing. The conclusion was reached that individual blocks or "stopes" would be the best solution rather than retreating along panel strips of indefinite length.

At first a block area of 150x300 ft. was selected, and eight out of nine stopes were successfully completed. The ninth stope was a pillar stope and gave trouble from excessive weight. The block area was reduced to 150x150 ft., and these dimensions were generally adopted. Raises were extended at each corner, and from these, drifts 7½ ft. high were extended at vertical intervals of 30 ft., weakening the vertical boundaries of the block 25 per cent; by extending the backs of the drifts, side weakening could be increased to 50 per cent. Afterward the interval between weakening drifts was increased to 45 ft. and the backs of these were drilled and blasted to yield a weakening of 33⅓ per cent.

ASSUMING a unit ore block 150 ft. square and 300 ft. in height, weakened on four sides by raises at the corners and side drifts accounting for some 33⅓ per cent of the contact area, a volume-weight index of 12.5 cu.ft. per ton, the area at the sides of the block subjected to vertical shear would be 120,000 sq.ft. The weight of the block would be 540,000 tons and the shear per square foot of side area would therefore be 4.5 tons. With 50 per cent weakening this would be 6 tons per square foot for a complete undercut. The maximum figure would give a shearing weight of about 83 lb. per square inch of side area.

The physical constants of the Miami ore not being known, comparison with its shearing strength cannot be made. For zero side weakening the shearing stress would be 3 tons per square foot, or 41.6 lb. per square inch of side surface. Weakening to the extent of one-third increases the shearing stress 50 per cent, and to one-half doubles it.

Assuming a width of weakening drift of 4 ft., the total volume of weakening, on a 33⅓ per cent basis, equals 240,000 cu.ft., or 19,200 tons, giving a ratio of about 28 tons of ore caved to 1 ton of material broken in the narrow work. This ratio would be reduced to 18.75 tons for a 50 per cent weakening.

THE total block area undercut is 22,500 ft. Maximum weight active upon the bottom and incident upon the drawing openings would be 45,000 tons, which is based upon the assumption that only that weight included within the volume of a pyramid of 150 sq.ft. base and an altitude of 75 ft. would be supported by the bottom. In turn, this is based upon the grain-bin theory that part of the weight is supported by side thrust. I have made computations to determine the weight of the solid pyramid, but it is obvious that the ore would be broken and therefore occupy a greater volume per unit of weight. On this account the active weight might be two-thirds of the weight given. However, on the basis of the first figure, the average per square foot of bottom area would be 2 tons.

Active weight or "live tonnage" is independent of the height of the block but dependent upon its width and length. A caved area 300x300 ft. would give an active weight of 360,000 tons, or an average of 4 tons per square foot of bottom area. An undercut area of 100 ft. square, on the other hand, would indicate a "live tonnage" of 13,333 tons, or 1.33 tons per square foot of drawing area. In view of what Maclennan states, "the area of the stope is of the first importance," these theoretical figures representing "live tonnage" are of great interest. Under the conditions at the Miami mine, a live tonnage averaging 2 tons per square foot of drawing area results in reasonable maintenance upon the structures within the grizzly level and chute set zone. On the other hand, a live tonnage averaging 4 tons per square foot would cause excessive weight and increase the maintenance work upon draw openings and structures.

RAPIDITY OF DRAWING—Another factor influencing "live tonnage" is the rapidity of drawing caved ore. Rapid drawing undoubtedly lessens the effect of live tonnage, and on the other hand a slowing up of this process brings the element of momentum into play and undoubtedly causes an increase in the effect of live tonnage. However, the rapidity of drawing is influenced by the rapidity of caving and breaking up. Gravity stress takes an appreciable time to assert itself, which fact is exemplified by the statements: "Immediately after undercutting of the stope is completed ore drawing is started. It is slow work to begin with, because the first ground caved usually arrives at the chutes in fairly large pieces. Sometimes the stope back hangs up and drops only a very little ore for several weeks, but this is unusual."

The average rate of drawing, obtained by averaging figures given by Maclennan after omitting some low rates,

is 1,220 tons per day, which would give for a block tonnage 442 days within which to complete drawing. Maclennan states that 17.06 sq.ft. of area is required per ton of ore produced daily and the average thickness of solid ore drawn is 0.733 ft. The last figure would give 408 days for caving and drawing a block 300 ft. high and 150x150 ft. base area.

THE rapidity of caving is a function of block width and the physical nature of the ore mass. The wider the block, the more rapidly and in greater effect will gravity stress assert itself; and the stronger the ore mass, the greater will be its resistance to caving and the more important becomes the factor of side weakening. But the breaking of the ore must be also accomplished, and this is apparently brought about by the working or movement of the caved mass upon itself. At first drawing is retarded until a sufficiently large mass of caved rock accumulates to bring about conditions for breaking. The rate of drawing thereafter should be such that the mass of moving rock increases rather than decreases. Undoubtedly there is always more or less void space above the caved ore. Only by experience with a given orebody can the requisite rate of draw to accomplish this end be determined. Strength of ore mass must be considered. Undoubtedly the stronger the ore, the slower must be the rate of drawing. The test is the proportion of oversize pieces that appear at the chute sets. Too slow a rate of drawing, on the other hand, may result in packing where the ore is soft or in excessive weight on the timber structures. The practical mining man must not overlook the fact that some ore masses are too strong to be satisfactorily worked by undercut caving.

CONTROL OF DILUTION—It will be conceded that the mining of definite units, as contrasted with panel retreating, results in better control of top dilution. The drawing down of a caved block so that the level of broken cap rock is horizontal is accomplished by the close spacing of draw foci and close supervision of the drawing process. Side dilution is prevented by the weakening drifts which establish a more or less definite line of break within the ore mass. Even in the mining of peripheral blocks, side dilution does not appear to be very important. However, in mining pillar blocks which may have contiguous masses of packed waste rock on two or more sides, dilution enters to a greater extent, but this was overcome by the expedient of leaving thin partitions of ore between the original and the pillar stope. Such partitions, 15 ft. in thickness, were left between the sides of all stopes and at some ends and at other ends omitted. Later the partition was reduced to 7½ ft. in thickness.

Maclennan states that the best pillar stope, bordered by waste rock at one end and side, gave almost the same tonnage extraction as the best original stope, but that the grade extraction was 10 per cent lower. He also states that in drawing the pillar stopes no serious trouble was experienced from waste rock drawing in from the adjoining, previously mined stope. Moreover, the packing of the waste rock made a substantial side support in mining the pillar stopes. It is of interest to note that more or less of the ore left in partitions was recovered. The adequacy of the unit method of undercut caving with respect to dilution is given by the total of 115 per cent tonnage extraction; 88.93 per cent grade, and 102.4 per cent copper.

SUBSIDENCE—This is only scantily treated in Maclennan's paper, but that does not detract from the value of the paper. All interested in the subject will hope that Maclennan will present it in another paper, since the opportunity for an interesting study is excellent. Particularly that Maclennan will give figures representing the degree of consolidation of the caved cap rock between pillar stopes and the time element involved in cap-rock caving to the surface as well as the lateral sapping. The area of the orebody, some 100 acres; its average thickness, 325 ft.; and its cover, of 250 to 500 ft. in thickness, represent an enormous volume of rock, the behavior of which during and subsequent to mining operations should receive intensive study.

Respecting the economics of undercut caving, the completeness of the cost data in Maclennan's paper is noteworthy. The more important ratios are as follows: Average tons mined per shift underground, 27; timber consumption, 1.045 bd.ft. per ton mined; explosives, 0.2225 lb. per ton of ore, which includes 0.05 lb. for ore drawing (principally used in chute blasting) and 0.1725 lb. used presumably for narrow work; power consumption, 1.9 kw.-hr. per ton mined, which includes about 1 kw.-hr. per ton for hoisting. Mining costs over a four-year period averaged $0.40 per ton, of which 25 per cent was for development; 35 per cent for drawing or stoping; 21.5 per cent for haulage and hoisting; 11.5 per cent for ventilation, general underground, engineering and sampling; and 7.5 per cent for mine surface and mine accident expense. I have estimated the development ratio, applying particularly to single block unit (300 ft. in height) as approximately 1 cu.ft. of development to 18.7 cu.ft. of ore made ready for mining.

MAINTENANCE work in caving is given in a tangible way. Maclennan states that in the mining of thirteen stopes, involving 802 chute sets, 314 of these required complete replacement (39.2 per cent); a few had to be replaced several times; and total replacements were equivalent to 862 sets. Three hundred and forty-one sets (42.5 per cent) required no repairs; and labor maintenance was distributed as 79.1 per cent for complete repairs and 20.9 per cent for minor repairs. This is an illuminating exposure of what takes place at the chute-set level in undercut caving. It also probably indicates an important point where improvements either in design or selection of materials used, or in the broader features of the mining method, might be made.

The new Balatoc gold mine and mill, in the Philippine Islands. Benguet Consolidated controls Balatoc.

LOCOMOTIVE HORSEPOWER CHART

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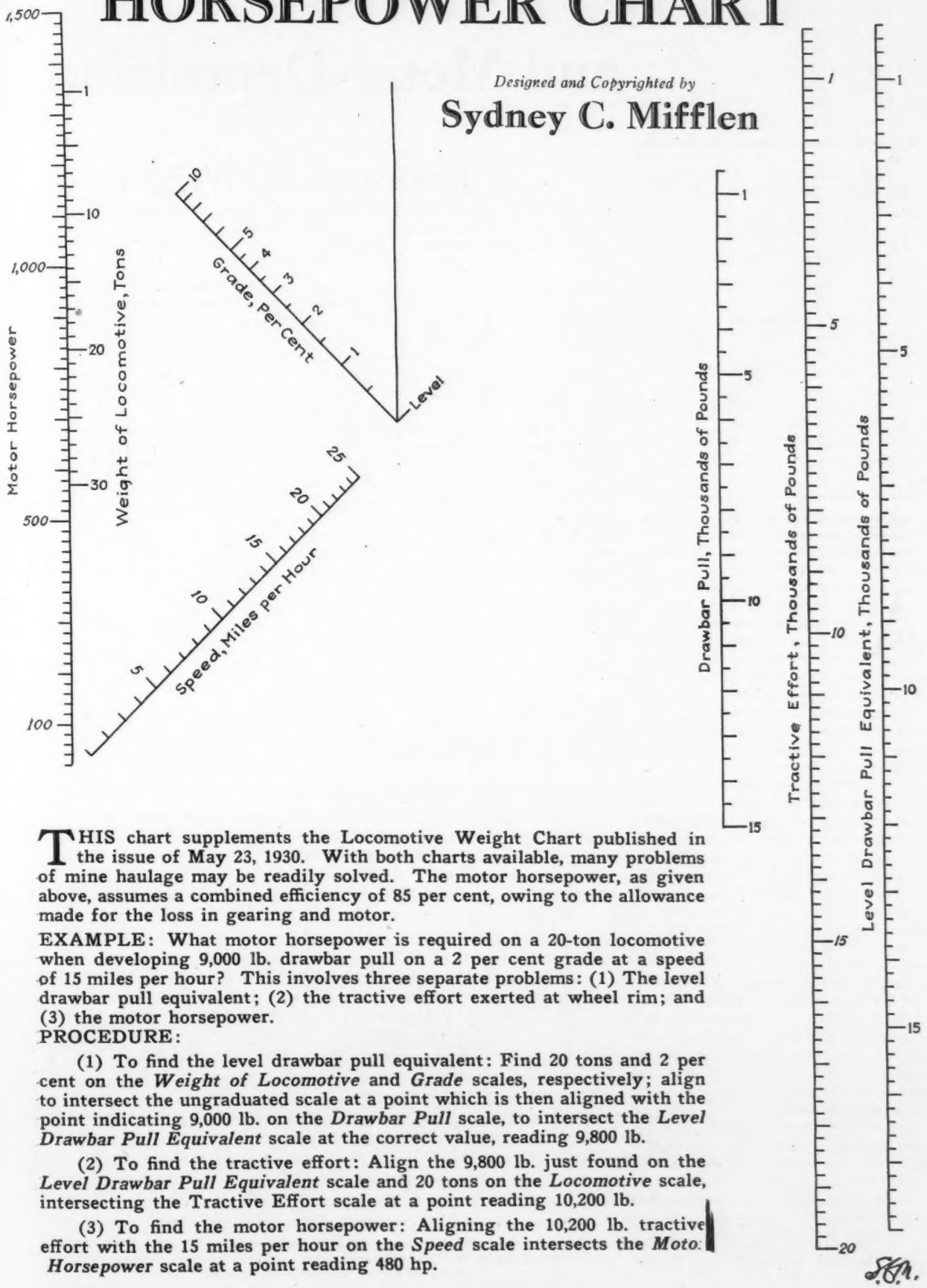
Sydney C. Mifflen



THIS chart supplements the Locomotive Weight Chart published in the issue of May 23, 1930. With both charts available, many problems of mine haulage may be readily solved. The motor horsepower, as given above, assumes a combined efficiency of 85 per cent, owing to the allowance made for the loss in gearing and motor.

EXAMPLE: What motor horsepower is required on a 20-ton locomotive when developing 9,000 lb. drawbar pull on a 2 per cent grade at a speed of 15 miles per hour? This involves three separate problems: (1) The level drawbar pull equivalent; (2) the tractive effort exerted at wheel rim; and (3) the motor horsepower.

PROCEDURE:

(1) To find the level drawbar pull equivalent: Find 20 tons and 2 per cent on the *Weight of Locomotive* and *Grade* scales, respectively; align to intersect the ungraduated scale at a point which is then aligned with the point indicating 9,000 lb. on the *Drawbar Pull* scale, to intersect the *Level Drawbar Pull Equivalent* scale at the correct value, reading 9,800 lb.

(2) To find the tractive effort: Align the 9,800 lb. just found on the *Level Drawbar Pull Equivalent* scale and 20 tons on the *Locomotive* scale, intersecting the Tractive Effort scale at a point reading 10,200 lb.

(3) To find the motor horsepower: Aligning the 10,200 lb. tractive effort with the 15 miles per hour on the *Speed* scale intersects the *Motor Horsepower* scale at a point reading 480 hp.

Pressure Zones and Metal Deposition

Lawrence B. Wright

Chief geologist, Homestake Mining Company, Lead, S. D.

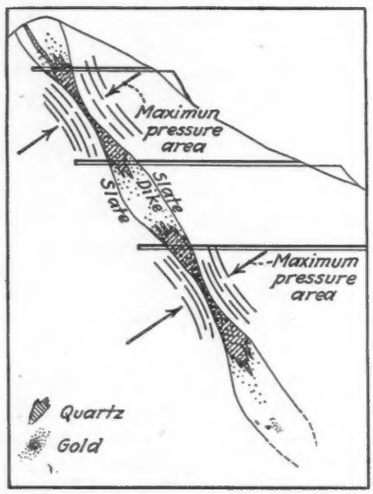


Fig. 1—Showing in a California deposit mineralization within areas of maximum wall resistance or maximum pressure areas

A NUMBER of years spent in the examination and study of many types of ore deposits have left me with an impression relative to the causes of the loci of ore deposition which seems worth recording and offering as a possible additional guide to ore under conditions where the principle herein explained might apply.

In general, ore deposits are accounted for as to location and value by the terms "structural control," "solution channels," "permeability," "favorable host rock," and similar phrases, all of which of course are important. The rôle played by the mining geologist seems sometimes to be that of a person who explains something if it happens, or explains it with equal facility if it does not happen, which may be partly excusable on the ground that there is still much more to be known relative to ore deposition. The following is submitted with the hope that those more familiar with the phenomena of ore deposition will find in the plea expressed something of sufficient merit upon which to build.

Stated in terms of a general proposition applicable, as has been frequently observed, to a number of ore deposits, the observation is this:

In a metalliferous area, maximum mineralization can be expected within or adjacent to areas of maximum wall resistance or maximum pressure areas.

For example, in a California gold deposit[1] the following situation is encountered: The gold occurs in an acid porphyry dike associated with quartz, pyrite, galena, and sphalerite. The dike pinches and swells in plan and section. Best values are found where it passes into or emerges from a pinch; the poorest where the dike is widest. Fig. 1 crudely illustrates this occurrence. In this instance it is assumed that the dike is narrow in certain areas, owing to the fact that wall-rock resistance was greater in these areas at the time of intrusion. Hence the narrow areas in the dike represent those parts of it which have been subjected to or have combated the maximum local resistant pressure. In Fig. 1 has been indicated the maximum pressure areas.

The term "maximum pressure area" as it is applied here is given considerable flexibility of meaning. After consideration of the other following types of deposits in this relationship, it will be more apparent that some better term might be chosen, although it, too, would have to be general in its application.

In the Hallsted deposit, the dike itself is the host rock. Very little quartz or other mineralization is found in the adjacent wall rocks. Some pyrite is found in the slates near the contacts and often very good values in gold are found in the contact selvage. The wide parts of the dike are little altered, but the narrower parts are sericitized, sheeted, and in general considerably replaced by quartz. The repeated occurrence of mineralization in this relationship in a dike several thousand feet in length and exposed throughout a vertical range of 1,500 ft. forces the conclusion of a direct bearing upon mineralization of the constricted areas. During the dike invasion, it is assumed, the pressure exerted by the dike on the wall rocks was uniform. Given uniform resistance in lesser amounts along the walls, the dike would be of uniform thickness. But as it is not of uniform thickness, one must conclude

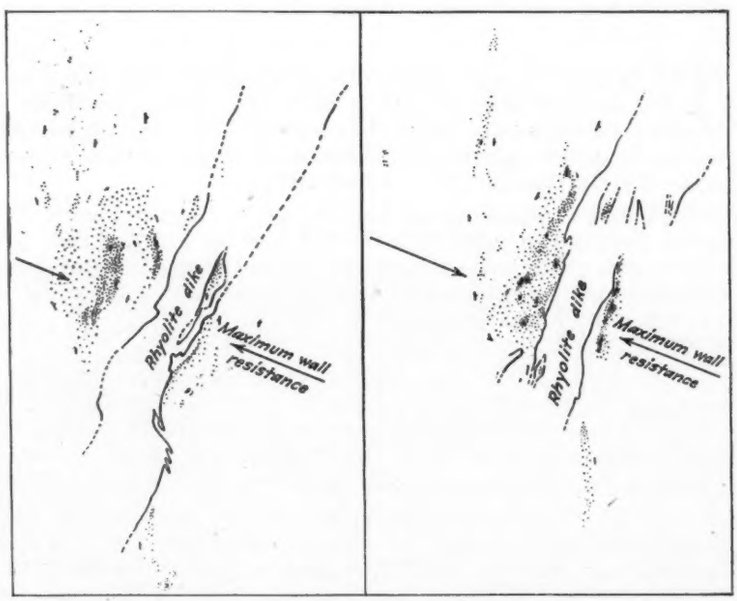


Fig. 2—Rhyolite dike zone and gold deposition on two levels of Homestake mine, Lead, S. D., showing mineralization opposite (within) areas of maximum wall resistance or maximum pressure areas

[1]The Hallsted Group, Plumas County, Calif.

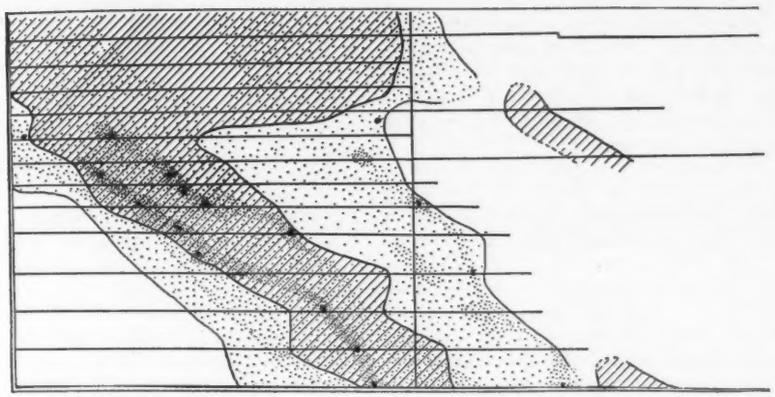


Fig. 3—Longitudinal projection, on vertical plane, of constricted area of dike zone (hatched area) and range and intensity of gold deposition (dotted areas) for part of Homestake mine, Lead, S. D.

that the wall resistance was not uniform at all points, being greatest where the dike made the least headway in forcing an opening. It is barely possible that at such an area of maximum resistance or contra pressure the internal structure of the dike was affected in some manner favorable to mineralization. To these areas the term "maximum pressure area" is applied. The general picture of mineralization in such an area, for handy use in the field, gives the idea of pressure applied normal to the dike walls.

Another outstanding example of such a relationship as that expressed in the foregoing is found in the Homestake gold deposit. The application of the idea of a resistant wall-rock area is in this case somewhat complicated, but it can be shown that gold deposition occurred in such an area. In this occurrence we find the effect of the maximum pressure area, as indicated by the constriction of a rhyolite dike series, to be gold deposition by replacement of the Homestake formation in part, which is the favorable horizon. All of the wall rocks adjacent to the dike zone are not amenable to mineralization; hence, some irregularity is found in the distribution of gold within the area in question.

The general details of the geology of the Homestake mine have been adequately given[2]. To illustrate further the proposition stated, a plan of dikes and gold deposition on two levels, taken at random, is given in Fig. 2. The relationship illustrated holds for any part of the mine through a present vertical range of 2,600 ft. The deposition of gold occurs opposite the constricted area of the dikes, and, as will be seen, has evidently been influenced by the same structural features which caused the dikes to be constricted. In this formation the dikes serve merely as the key to the area of maximum resistance or maximum pressure area. Application of the latter term in this instance is justified on the following grounds which are explained in detail:

Granted that the dikes are constricted because of the local stubborn resistance of wall rocks, it is possible that mineralizing solutions, having reached a temperature and pressure sufficiently low to permit deposition, were locally impeded in their progress on encountering this area. The myriad of channel-ways with their invading mineralizer can easily be conceived to have been subjected to the same reaction as that which obtained in the Hallsted dike mineralization, the result in either case being mineralization within an area of locally resistant wall rock, the difference being that in one occurrence the dike was the host and in the other a stratum of the wall rock, but within the maximum (local resistant) pressure area.

A longitudinal projection of the Homestake deposit showing the constricted area of the dike zone and gold deposition also shows a striking relationship. The pattern of gold distribution follows almost intimately that of the dike constricted area. A part of this projection is shown in Fig. 3. In making this projection, first, on a geological map of each level the narrow stretches along the dike zone were outlined. It was assumed, as already stated, that where the dikes are narrowest that condition existed because of their inability at the time of intrusion to force the wall rocks farther apart; hence an area of maximum wall resistance or maximum pressure area. This having been determined for each level, a longitudinal projection on to a vertical plane parallel to the strike of the rhyolite zone was made of the entire mine, outlining from top to bottom the configuration of the narrow area of the dikes.

The dikes extend for considerable distances beyond the limits of the constricted zone and finger out into a broad zone made up of several members. Would there be any similarity in the projected pattern of gold deposition? If so, some relationship would certainly be expressed or suggested. Accordingly, from the assay maps values were plotted on the same section, everything above $3 per ton being considered and shown by dotted areas. Values above $10 per ton were shown by more closely spaced dots and those with assays of $30 or more in heavy black. As can be seen in Fig. 3, there proved to be a striking similarity in the areas of gold deposition and the maximum pressure area. A study of the completed section suggests the following observations, although they may not all be evident from the portion here shown:

1. The lateral deposition of gold is proportional to the lateral extent of the dike constricted area.

2. Maximum deposition occurs opposite (normal to the dikes) the general center of the constricted area.

3. Near sudden flexures of the constricted area is observed some evidence of increased mineralization.

4. Two smaller constricted areas away from the main constricted area are found opposite isolated bodies of ore which are unattached to the main orebodies except by the continuation of intervening barren host rock. No satisfactory explanation has heretofore been offered for these isolated bodies.

5. The richest ore is found within

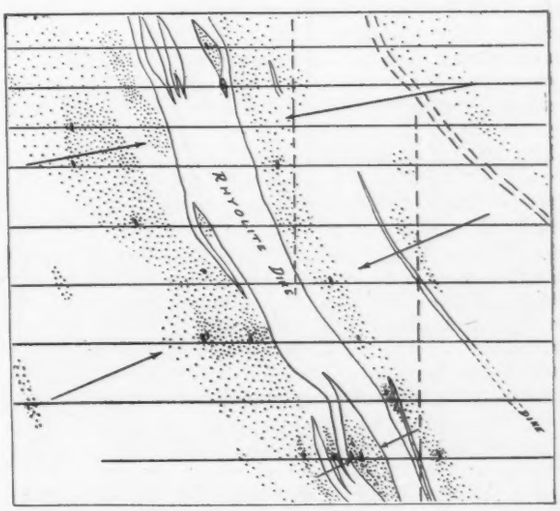


Fig. 4—Transverse section along general center of dike constricted area or maximum pressure area, showing increase in intensity of gold deposition opposite areas of increased wall-rock resistance, even within maximum pressure area, Homestake mine, Lead, S. D.

[2]*Engineering and Mining Journal*, May 5 and 12, 1923. Also, Bulletin 765, U. S. Geological Survey.

the center of the constricted area where the dikes apparently surround the ore. It is not clear what application this observation may have, except as possibly governed by paragraph 2.

6. Beyond the vicinity of the constricted area are found folds in the host rock which to all appearances are as favorable to mineralization as those near or opposite the constricted area, but which are not of commercial grade and are in fact, mostly barren.

Attention is called again to the sketches of the two levels shown in Fig. 2. A glance will show that whereas the strike of the host rocks (not shown separately) is generally across that of the dike zone at an acute angle, the general distribution of gold conforms to the trend of the dike zone. This is much more apparent when considering the mine as a whole. The lines of shearing and weakness generally trend parallel to the beds. A study of the whole mine gives the following:

Average strike of host rock, N. 28 deg. W.
Average strike of shear zones, N. 26 deg. W.
Average strike of dikes, N. 13 deg. 12 min. W.
Average strike of ore, N. 13 deg. 18 min. W.

Though the details of the complex folding are not shown, the trend of ore does conform to the trend of the beds and is found in detailed distribution, within the general vicinity of the dike constricted area, to be locally controlled by structural features, principally folds. Where the host rock trends beyond the vicinity of the dike constricted area, the mineralization can be seen fading out along such a bed or limb of a fold. This is especially true in the north-end workings on the old levels.

The bearing of the observations previously stated is evident. Where no other particular definite guide to a central or main group of ore channels is in evidence, one might expect ore indiscriminately throughout the great reaches of favorable host rock, but so far as development has extended in depth, the constricted areas of the rhyolite dike zone can be seen to have faithfully pointed out the general limits of mineralization, and also the trend.

I emphasize at this point the fact that in the Homestake type of occurrence it is not necessary that there be a genetic relationship between the dikes and the ore. The dikes merely indicate the presence of a physical situation in the wall rocks which quite certainly has affected the distribution of gold, whenever introduced.

To complete the study with reference to this deposit, a transverse projection was made along the general center of the dike constricted area and normal to the strike of the dike zone (Fig. 4). As the level sketches show the gold deposition to be generally parallel to the trend of the dike zone in a major sense, so also does the transverse section show the gold deposition to be parallel to the dip of the dike zone. Also, in transverse section, host rock extends beyond the limits of gold deposition on both sides of the dike zone for the entire vertical range as now exposed.

It is also noted that the transverse section indicates a variation of wall resistance throughout the vertical range shown and that there is a strong suggestion of an increase in lateral range and intensity of mineralization opposite the areas of maximum wall resistance, even within (down and along the center of) the constricted area.

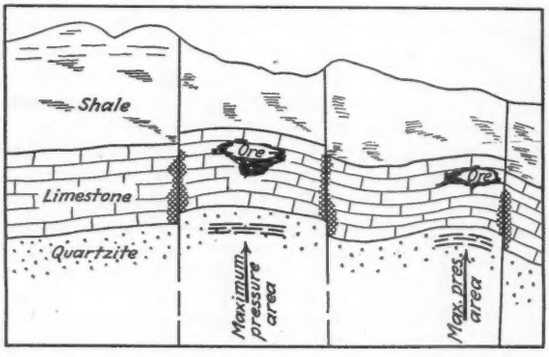


Fig. 5—Typical section of ore occurrence in Flat River district, Bonne Terre, Mo., illustrating mineralization opposite area of maximum pressure. Cross-hatched areas indicate where ore might be expected if permeability were the main control

To consider again the effects of a variation in size or lateral extent of the resistant areas, measurements were made of the length of the constricted area and the length of commercial ore on each level. Choosing four at random, the following results are given:

Length of Constricted Area, Feet	Length of Ore, Feet	Ratio
370	1,280	3.46
140	480	3.43
1,260	3,050	2.42
290	920	3.28

For the whole mine the variation is from 1.57 to 3.46. These figures would have little significance were it not for the fact that the excess in ore length (or area) is equally divided at either end of the limits of the constricted area, which seems to warrant the conclusion that *whatever determined the centrum of the constricted area also did the same for gold deposition.*

A third type of deposit might be considered. Four years ago some field work in the Flat River district near Bonne Terre, Mo., indicated that the lead ores there occurred in the higher blocks of a fault mosaic, which was not in all probability a new observation. Since then Dr. W. H. Emmons has conclusively shown[3] that these higher blocks are gently arched into low anticlines and that these are the favored structural areas for ore deposition. Fig. 5 shows a generalized sketch of a typical section in this area, with the maximum pressure areas indicated. If it be assumed that the rocks subjected to maximum stresses would be those blocks relatively highest, obviously the maximum pressure areas would lie opposite (in this case below) these blocks. If the relative permeability were the only or the principal controlling factor, we should rather expect to find ore adjacent to the fault fissures, as indicated by the cross-hatched areas. Instead, it is opposite the maximum pressure areas. This example indicates why the term "maximum pressure area" is used flexibly in the several examples cited. The usefulness of the idea in the field as a guide to ore lies in the ability of the observer to analyze the mechanical aspects of geologic structures, applying the theory that ore may be expected opposite (within) areas of maximum pressure.

A fourth general type of deposit, that of oreshoots in quartz veins, might also be seen to be controlled by zones of relatively great wall-rock resistance or pressure areas. Examination of the horizontal sections with attention paid particularly to slight constricted areas, their rake and other characteristics may give a direct answer to the problem of trend of ore deposition within deposits of this type. Such occurrences would in a general way fall under the case illustrated in Fig. 1.

Other applications suggest themselves, such as the distribution of relative values in the filled-fissure type of vein. Values are generally higher in this type near or in a constricted area.

A pegmatitic vein at its narrow end may be imagined as having had at this point its greatest struggle against wall-rock resistance, meeting its area of maximum (resistant) pressure and giving up, as in some cases, auriferous quartz veins. This brings to mind the general set-up at the Hollinger mine where the quartz veins are pendant at the narrow end of a quartz porphyry mass. The pinch end of the mass might be regarded as the area of constriction, as in case No. 1 (Hallsted).

The mineralization at the old Treadwell, 700, and Mexican mines, on Douglas Island, Alaska, can be illustrated in Fig. 1 by that part of the sketch below a point midway between the two upper tunnels shown. A host of other examples could be cited where I have observed mineralization at its best opposite (within) areas of maximum wall resistance or maximum pressure areas.

[3] *Econ. Geol.*, Vol. XXIV, No. 3, May, 1929.

An Efficient Compressor Plant Installation

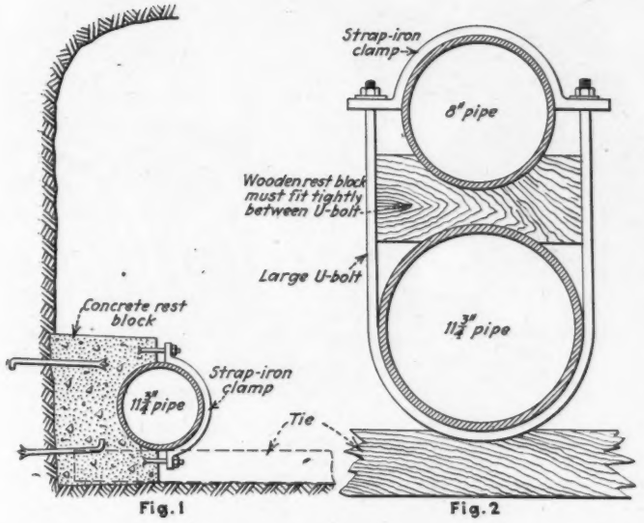


Fig. 1 and Fig. 2—Details of airpipe layout

ECONOMIES in operation and improved air conditions underground have recently been obtained by Silver King Coalition Mines, writes J. B. Huttl, assistant editor, Salt Lake City, Utah, by the installation of a modern compressor plant and pipe line at the King Consolidated tunnel, near Park City, Utah. The plant, with many interesting features, clearly illustrates the advantage of a central air generating and distributing system. Formerly, air for underground operations was supplied by four small compressor stations, at different points on the surface and underground, each of which was equipped with an individual network of pipe lines.

The new power house—a concrete and steel-frame structure provided with large windows and ventilators—contains an Ingersoll-Rand, Type PRE air compressor, driven by a 600-hp. General Electric synchronous motor, with a capacity of 3,000 cu.ft. free air per minute; a small motor-generator set; a switchboard; and a 5-ton Yale hand crane, to facilitate repair work on the compressor when necessary. Ample floor space is provided to accommodate a second compressor unit, which may be installed later. The compressor intake pipe is directly connected to a wooden air filter equipped with removable fine-wire screens; and two modern after-coolers, resting on a concrete foundation, are provided further to cool and dry the discharged air before it enters the main pipe line. A sufficient all-year-round water supply is available for cooling purposes. From a settling pond, fed by the tunnel drain water, the water is pumped to a large wood-stave surge tank, from which it is conveyed by gravity to the cylinder jackets, inter- and after-coolers.

The novel feature of the installation is the use of standard Youngstown 11¾-in. diameter, plain-end, gas-line pipe for the main air line, 12,000 ft. long, and the application of Dresser couplings, with which, because of their semi-flexible nature, excellent results have been obtained. When using this type of coupling, special care must be taken evenly to distribute the end strain on each pipe section—in this case consisting of 40-ft. double random lengths welded at the factory—by a proper anchoring of the pipe line. This was successfully accomplished by placing concrete blocks equipped with strap-iron clamps at every 2,000 ft., to hold tightly the pipe in place, as shown in Fig. 1. The uniform prevailing temperature in the tunnel made expansion joints unnecessary. The advantages of large fittings, such as ells, tees, and others, is well known and needs no further explanation. These fittings, carefully designed according to prevailing underground conditions, were made at the company's machine shop, of 11¾-in. gas-line pipe, built in small sections and welded together by the acetylene process.

A second pipe line, 8 in. diameter and 17,000 ft. long, connected to the new compressor plant of the Silver King Western Mining Company, is placed above the main pipe line, and supported by a series of special clamps, comprised of a wooden creosote-treated rest block and a large close-fitting round-iron U-bolt, with its strap-iron drop-forged clamp, placed at 40-ft. intervals, as illustrated in Fig. 2.

The fact that a uniform air pressure of about 100 lb. is maintained at all locations underground, when the compressor is delivering air at 105-lb. pressure, demonstrates the over-all efficiency of this modern plant.

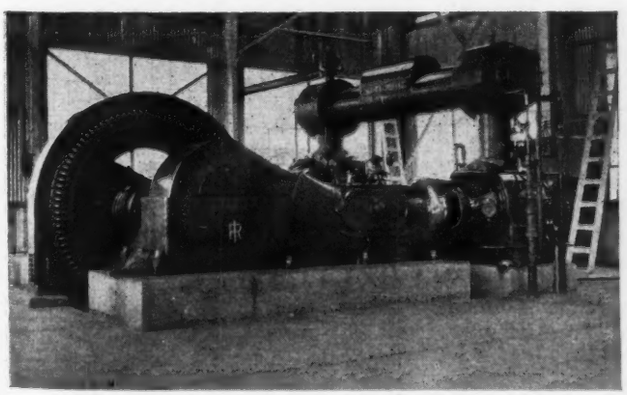


Fig. 3—The compressor at Silver King Coalition

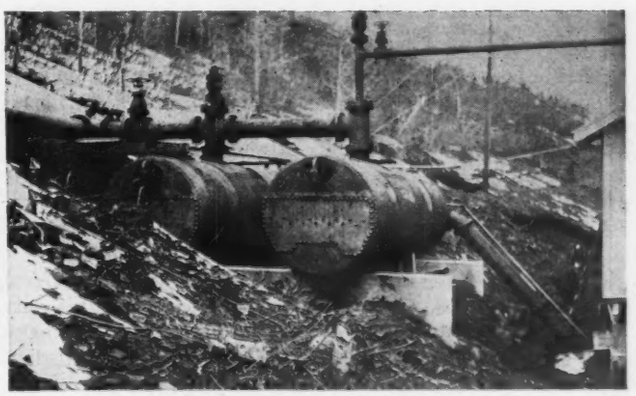


Fig. 4—After-coolers outside the compressor house

Automatic Hoisting

at the Emma Nevada Shaft

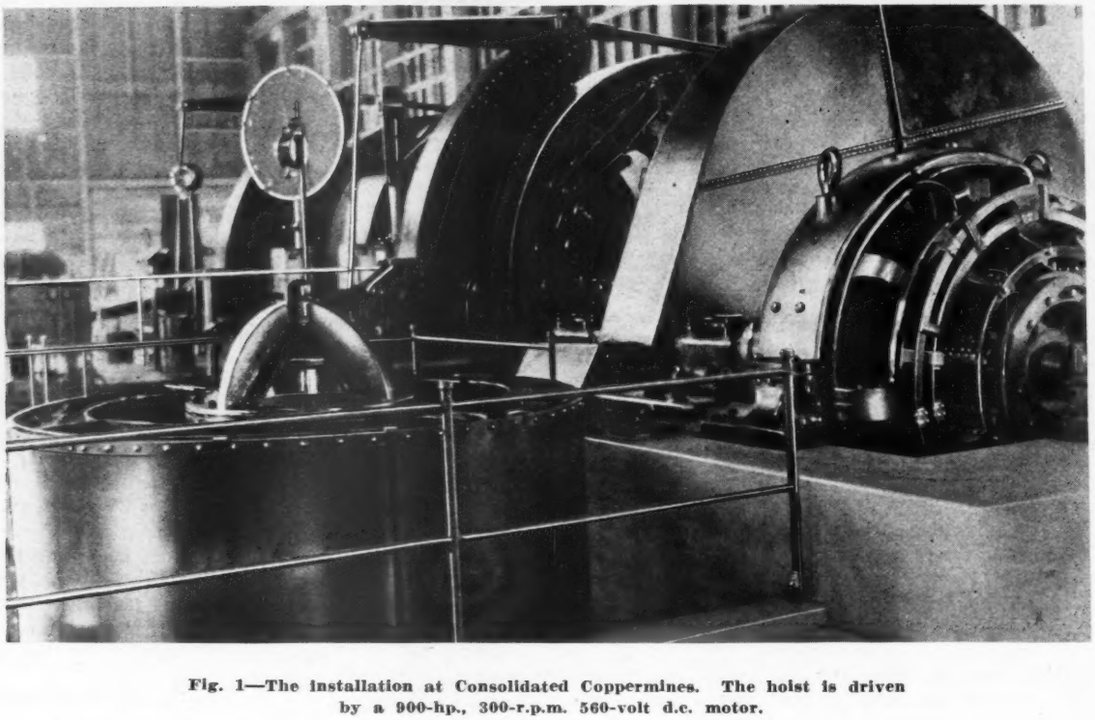


Fig. 1—The installation at Consolidated Coppermines. The hoist is driven by a 900-hp., 300-r.p.m. 560-volt d.c. motor.

J. E. Borland

Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

ONE of the major advantages of the variable-voltage system as applied to mine hoisting is the great reliability and accuracy of control of the motor speed under widely varying conditions of operation. In the usual arrangement, the direct-current hoist motor and the generator supplying it are both shunt-wound, separately excited machines, and control of the motor is effected principally by varying the strength of the generator field and thereby the voltage applied to the motor armature. In this manner, any desirable number of speed points can be readily obtained over the full range, from maximum down to creeping speeds. Furthermore, an inherent characteristic of this combination, when properly designed, is that on any control point there is little variation in motor speed over a wide range of torque, positive or negative. The accurate control which the system affords is due principally to this characteristic.

In most variable-voltage hoist installations the operator is provided with a multi-point, reversing master controller, supplemented by various protective devices and automatic relays to limit the torque during acceleration and retardation or to limit the rate of acceleration to a definite predetermined value. Provision is also made for automatic retardation as the limit of travel is approached by reinsertion of resistance in the generator field circuit, either by a mechanical device returning the master controller gradually to the "off" position or by opening of contactors in the generator field circuit through the medium of a geared limit switch. This feature is particularly desirable on hoists operating at high rope speed, of which there are many in service, up to speeds of more than 4,000 ft. per minute.

Although most equipments of this type are under control of the hoist operator continuously throughout the hoisting shift, a minimum of attention is required on his part with the protective features mentioned. With faulty or careless manipulation of the master controller, proper acceleration and retardation of the hoist are taken care of automatically. In fact, it is only at the initial start and at the final stop of the hoisting cycle that any action is really necessary on the part of the operator, and, in many cases, he relies entirely on the automatic devices to control the remainder of the cycle properly. With correct adjustment, this makes for the most efficient service from the standpoint of time saving, since the automatic control is practically constant in operation, a condition which can be approached only by the most skillful operator.

Under certain mining conditions, particularly at metal mines where production comes from only a few levels and the hoist operates over long periods from any one level, it has been found advantageous to free the operator for other duties, save for giving occasional attention to the hoist to reset the drums and the control for different levels. As these plants usually have other equipment, such as air compressors and converting apparatus for the haulage system, the attendant can thus devote a large part of his time to its care.

Of hoists arranged for automatic control, the one most recently installed is that of the Emma Nevada shaft of the Consolidated Coppermines Corporation, which was placed in operation in Feb-

ruary, 1929. Its scheme of control differs somewhat from that used in previous installations, so a description of the electrical features is given in the following.

Hoist Duty.—The hoist duty for which this equipment was selected is given in the table:

Hoisting Data, Emma Nevada Shaft of Consolidated Coppermines

Shaft	Vertical
Hoisting distance from first level, feet	646
Hoisting distance from second level, feet	826
Weight of ore per trip, pounds	24,000
Weight of empty skip, pounds	21,000
Diameter of rope, inches	1⅞
Type of drum	Double cylindrical
Diameter of drums, feet	12
Maximum rope speed, feet per minute	900
Maximum drum speed, r.p.m.	23.8
Time of acceleration, seconds	10
Time of retardation, seconds	10
Rest period, seconds	10
Operation	Normally balanced

Fig. 2 shows the calculated duty cycle on the basis of which the electrical equipment was applied.

Mechanical Parts. — All mechanical parts of the hoist were furnished by Nordberg Manufacturing Company. The hoist is of the double cylindrical type, with drums of 12-ft. diameter and 60-in. face grooved to wind 861 ft. of 1⅞ in. rope with three idle or "holding" turns. The drum shells are of heavy rolled steel plate bolted to cast-steel end rings carried on a cast-iron spider. To the end rings and spider are bolted the cast-iron brake rings and to these the clutch rings.

The brakes are of structural steel, 14 ft. in diameter and 21 in. face, lined with bass wood. They are of the parallel-motion type set by weights and released by hydraulic thrust cylinders.

Both drums are clutched to the shaft by axial plate clutches, which, like the brakes, are operated by hydraulic thrust cylinders using oil under pressure supplied from an accumulator. Operating levers for the brakes and clutches are located on the hoist platform and are interlocked to prevent releasing the clutch on either drum until its brake has been fully applied.

Hoist Motor and Flywheel M-G Set.—Fig. 1 shows the hoist in operation

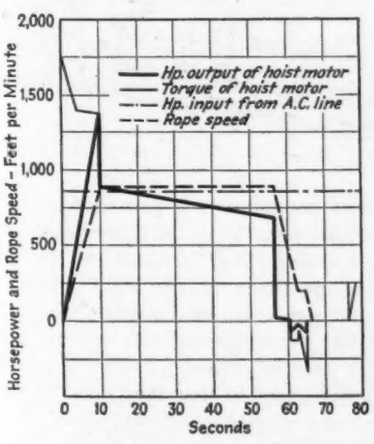


Fig. 2—Calculated duty cycle of hoist operating from 826-ft. level

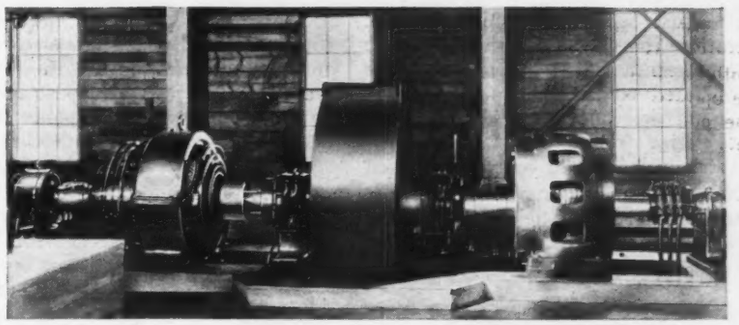


Fig. 3—The flywheel motor-generator set is a 750-kw. 560-volt, 900-760-r.p.m. unit

driven by a 900-hp., 40-deg. C., continuous-rated, 560-volt, 300-r.p.m., direct-current motor which is connected to the pinion shaft by a flexible coupling. The motor fields are designed for separate excitation at 250 volts.

Power is supplied to the motor by a 750-kw., 560-volt, direct-current generator with fields separately excited at 250 volts and provided with pole-face, compensating windings. The generator forms part of the flywheel motor-generator set shown in Fig. 3 and normally operates over a speed range of 900 to 760 r.p.m. A light differential series field is used on the generator to neutralize as much as practicable of the residual magnetism in the generator fields when the controller is in the "off" position, and thus minimize circulating current in the armature circuit.

The flywheel used on this set, with a weight of 35,000 lb. and diameter of 8 ft., is designed for complete equalization of the load on the a.c. line, to hold the input to the set approximately to the value shown in Fig. 1, with a drop of 12 per cent from the normal full load speed of 860 r.p.m. The set is driven by a wound-rotor, 850-hp., 550-volt, three-phase, 60-cycle, eight-pole induction motor. A 14-kw. 250-volt exciter supplies the fields of the hoist motor and generator as well as the control equipment and brake magnets.

Automatic Liquid Slip Regulator.—As part of the load equalizing system, an automatic liquid slip regulator is connected in the rotor circuits of the induction motor driving the flywheel M-G set. This regulator is of the conventional design commonly used on equalizer-variable voltage hoisting equipment.

System of Control.—As in the usual variable-voltage system, the armatures of the hoist motor and generator are connected permanently in series, and control of the motor is obtained principally by reversal and variation of the generator field excitation. Reversal of the generator excitation causes a reversal of the voltage applied to the motor armature and thereby of the direction of rotation. Increase or decrease of generator voltage through variation of its field strength produces a corresponding change in motor speed. The motor field current is automatically increased when the armature current exceeds a predetermined value during acceleration, and when the motor is at rest the excitation is lowered to reduce heating. The field currents of the hoist motor and generator are controlled entirely by magnetic contactors, which, with automatic and protective relays, are assembled as part of the switchboard

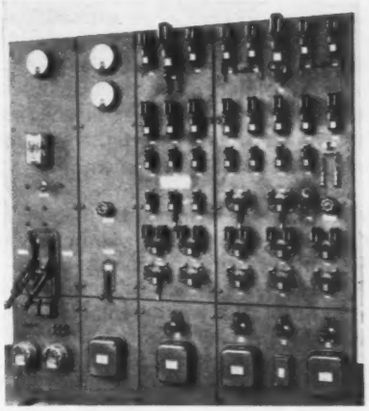


Fig. 4—Switchboard and control panels

which is shown in the cut in Fig. 4.

The controller is designed primarily for automatic operation of the hoist, each trip to be started by closing of a push button at the skip loader's station on either of the two mine levels. A third push button on the hoist platform is used for test purposes. At each point a single button is used to start the hoisting trip, after which the complete cycle, including acceleration, full-speed running, retardation, and the final stop at the dumping point, is controlled automatically. At the conclusion of each hoisting cycle the circuit is automatically set up for a reversal of rotation on the succeeding cycle, so that the skip loader has only one button to operate, requiring a minimum of attention on his part.

Provision is also made for manual operation of the master controller by a lever on the hoist platform when changing the drum adjustment for the two levels or when hoisting and lowering men. A four-point selector drum is used to connect the control circuit

for manual operation or for automatic operation from any one of the three push buttons mentioned. The controller can be operated only in the manner or from the point determined by the setting of this selector drum.

A drum-type master controller is used to control the magnetic contactors in the generator and motor field circuits. As shown by Fig. 5, the master controller has a mechanism at one end for connecting permanently to the manual operating lever on the hoist platform. At the other end a connection is made through a small magnetic clutch and gear reducer to a small d.c. pilot motor which is used in automatic control. During automatic operation the magnetic clutch is energized and the manual lever, being permanently connected, moves with the master controller. For manual operation, however, the magnet clutch is deenergized, disconnecting the gear reducer and pilot motor, so that only the controller drum turns with the lever, requiring no more effort than ordinary manually operated equipment.

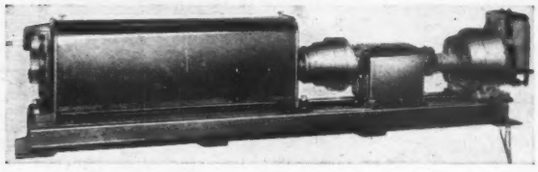


Fig. 5—Master controller and pilot-motor operating mechanism

Under manual control the rate of acceleration is determined by the operator unless he moves the lever so rapidly that the armature current would tend to become excessive; then the automatic accelerating relay and contactors come into play to hold the armature current to a predetermined value. Likewise, the rate of retardation is determined by the operator unless he moves the lever too rapidly toward the "off position," when an automatic retarding relay and contactors hold the regenerated current to a desirable value. If the operator fails to retard the hoist properly as the limits of travel are approached, automatic retardation is provided by traveling-nut limit switches geared to the two drums. Opening of these switches disconnects the generator field contactors and reduces the generator voltage in the same manner as would be obtained by movement of the master controller.

With the drum selector switch set for automatic operation from one of the three push buttons, and all safety devices closed, the magnetic clutch is energized, as previously mentioned, connecting the master controller to the small pilot motor. With one skip in the dumping horns and the other at one of the mine levels, the limit switches are closed in the proper combination for reverse motion of the hoist.

Upon pressing the start button corresponding to the setting of the selector drum, relays are energized on the control board to close the proper generator-field directional contactors and the pilot motor is started in the proper direction. Under automatic control an auxiliary solenoid is provided to release the hoist brakes when power is applied to the hoist motor and to allow the brakes to set when the generator field is de-energized to stop the motor.

The rate of acceleration of the hoist motor under automatic control is determined by the speed of rotation of the pilot motor turning the master controller, and a rheostat on the control panel is connected in the pilot motor circuit to permit adjustment of its speed to a value which will give the desired accelerating rate. The automatic current-limiting relay explained in connection with manual control is operative on automatic control as well, but the speed of the pilot motor is ordinarily of such value as to give a satisfactory accelerating rate without operation of the relay.

As successive contacts of the master controller close with rotation of the pilot motor, the corresponding generator field contactors are energized and the generator voltage is increased, until, on the last point, the voltage is up to a maximum value and the hoist motor is operating at full speed. With closing of the last accelerating contactor, an interlock opens relays in the pilot motor circuit and the master controller is stopped in the "full-on" position. The hoist motor then continues at full speed until the time retardation should begin, when the traveling-nut limit switches come into operation to provide automatic retardation. One of these limit switches, similar to that shown in Fig. 6, is geared to each hoist drum and carries four double-throw, quick-break switch units for each direction of motion. These units are given the required spacing and are clamped to longitudinal bars with their operating mechanism in the path of a nut traveling to and fro on a heavy square-thread screw driven by the hoist. Each limit switch unit is clamped to the rectangular bar by four screws, a construction which permits ready and accurate adjustment of the successive retarding points.

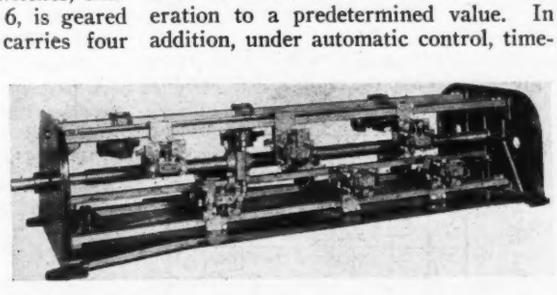


Fig. 6—Traveling-nut limit switch for automatic retardation (cover removed)

The limit switch contacts are each connected to a group of generator field contactors, so that opening of the first contacts at a predetermined point of travel re-inserts a section of resistance in the generator field circuit, lowers the generator voltage, and causes regenerative braking to lower the motor speed to a value corresponding to the voltage applied. Four automatic retarding stops are thus obtained during the latter part of each hoisting cycle, and at the end of travel the hoist is automatically stopped and the brakes are set by opening of track type limit switch.

With operation of the second traveling-nut limit switch contact on retardation, a circuit is established to rotate the pilot motor in the opposite direction and return the master controller to the "off" position. This proceeds during the retarding period, but as the generator contactors are opened by the traveling-nut limit switch in advance of the return movement of the master controller, the latter has no effect on retardation. The drum does not complete its return movement until a few seconds after the hoist has been stopped, and when the "off" position is reached the controller is stopped by opening of one of its contacts.

With opening of the third contact of the traveling-nut limit switch on retardation, the opposite contact closes and automatically establishes the circuit for the reverse direction of operation of the master controller and thereby of the hoist motor on the next automatic cycle. Each successive cycle under automatic control is performed in the manner described.

Protective Features

The various protective features included under either manual or automatic control are as follows:

Current Limit Acceleration—A relay and auxiliary contactors are used to limit the armature current on acceleration to a predetermined value. In addition, under automatic control, time-limit acceleration is provided by pilot-motor operation of the master controller.

Current Limit Retardation.—A relay and auxiliary contactors are used to limit the armature current on regeneration to predetermined value. These are used in connection with a reverse-power relay so that they may be given a current setting different from that of the accelerating relay.

Low Speed Relay.—On the final re-

tarding point an automatic relay and two auxiliary contactors are put in operation to hold a practically constant value of low speed with the skip in the dumping horns.

The four relays described in the foregoing are all of the same general design, shown in Fig. 7.

Field Forcing Relay.—An automatic relay and auxiliary contactor are used to increase the motor field strength when the armature current on acceleration reaches a predetermined value.

Field Protective Relay.—A relay is used to prevent operation of the hoist if any fault occurs to open the motor field circuit.

Field Economy Relay.—In the "off" position of the controller, a contactor is opened to reduce the motor field current, and thereby save heating and a small amount of power. The coil of this contactor is connected across the armature of a small shunt motor driven

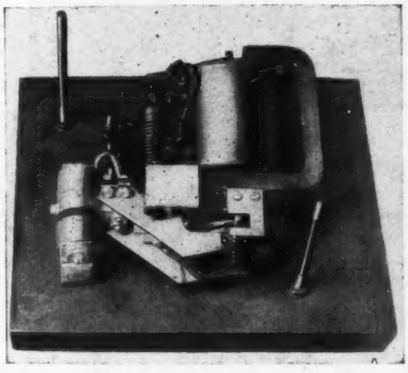


Fig. 7—Automatic relay such as that used for current-limit acceleration, current limit retardation and low-speed regulation (cover removed)

from the 250-volt d.c. control circuit. In the "off" position of the controller, the circuit to this motor is broken, but the stored energy in a small flywheel carried on its shaft maintains excitation on the contactor for a short time, which thus prevents weakening of the main motor field during the normal rest period of the hoist.

Exciter Contactors.—Two single-pole contactors are used to disconnect the control circuit from the 250-volt exciter, thus stopping the motor and setting the brakes upon opening of any of the emergency protective devices.

Safety and Brake Contactor.—A two-pole contactor de-energizes the exciter contactors and the brake trip coils on the opening of any of the protective devices listed herewith.

Emergency Push Button.—A push button on the hoist platform enables the operator to stop the hoist quickly in emergency.

Overload Relay.—An overload relay connected across an ammeter shunt in the armature circuit opens on excess current.

Over-travel Limit Switches.—Track-type limit switches installed in the head-frame open in case the hoist travels a short distance past the normal stopping point. These are supplemented by over-travel contacts on two Lilly controllers geared to the hoist.

Drum Back-Out.—A drum back-out switch on the hoist platform enables the hoist to be operated only in the reverse direction in case of opening of any of the over-travel limit switches. This back-out switch is arranged so that the hoist is stopped if an attempt is made to move it from its normal position when the equipment is in motion.

Overspeed Switches.—The Lilly controllers are each equipped with fly balls which open contacts on overspeed. These are supplemented by an overspeed switch driven from the hoist motor shaft.

Overspeed of M-G Set.—An overspeed switch on the flywheel M-G set stops the hoist motor and disconnects the induction motor driving the set in case of overspeed of the set from any cause.

Slack Brake Switches.—A switch is used with each drum brake to prevent operation of the hoist if the brake should tend to become slack through failure to adjust for wear of the lining.

Low Voltage Relay.—A two-pole low voltage relay is used to open the control circuit and set the brake in case of failure of the exciter voltage or opening of the exciter contactors. A reset contact on the master controller is used in connection with the low voltage relay, so that when the relay has opened the master controller must first be returned to the "off" position before operation can be resumed. When the hoist is operating under automatic control and has been stopped by opening of any of the emergency safety devices, therefore, the cycle must be restarted by manual operation of the master controller.

Switchboard.—The switchboard for the induction motor and exciter of the flywheel M-G set is of the conventional design. The primary circuit to the induction motor is provided with a three-pole oil circuit breaker equipped with under-voltage release and inverse-time-limit overcurrent relays. A second three-pole oil circuit breaker is provided to permit reversal of the induction motor torque to stop the motor-generator set quickly in emergency. This breaker is interlocked with the main breaker and also with the liquid slip regulator and an auxiliary contactor, so that the main breaker must be opened, the slip regulator plates at maximum separation, and a series grid resistor in circuit before the reversing breaker can be closed. The purpose of this interlocking is to keep the current drawn on reverse within a desirable value.

The exciter is provided with an automatic regulator to keep its voltage constant under the normal speed variation of the flywheel motor-generator set.

Suitable meters are provided for the induction motor and exciter and a pedestal on the hoist platform carries meters showing current and voltage in the hoist motor circuit and the speed of the hoist.

To those familiar with variable-voltage hoist applications it will be apparent that the installation here described incorporates practically all of the features of the ordinary type of equipment with additional devices necessary for full automatic control. In a sense, the term "full-automatic" might be considered inapplicable to this particular equipment, since closing of a push button is necessary to start each hoisting cycle. This, of course, was the form of operation desired, and it will be obvious that by the simple addition of a timing device, to give a definite interval for dumping and loading, the scheme of control described could be made to repeat its cycle of operation continuously.

It is to be expected, of course, that manual operation of the hoist will continue to be preferred for most applications. Under some conditions of mining, however, a system of automatic operation such as described is advantageous, and it is probable that the success of installations already made will lead to an extension of the field of application.

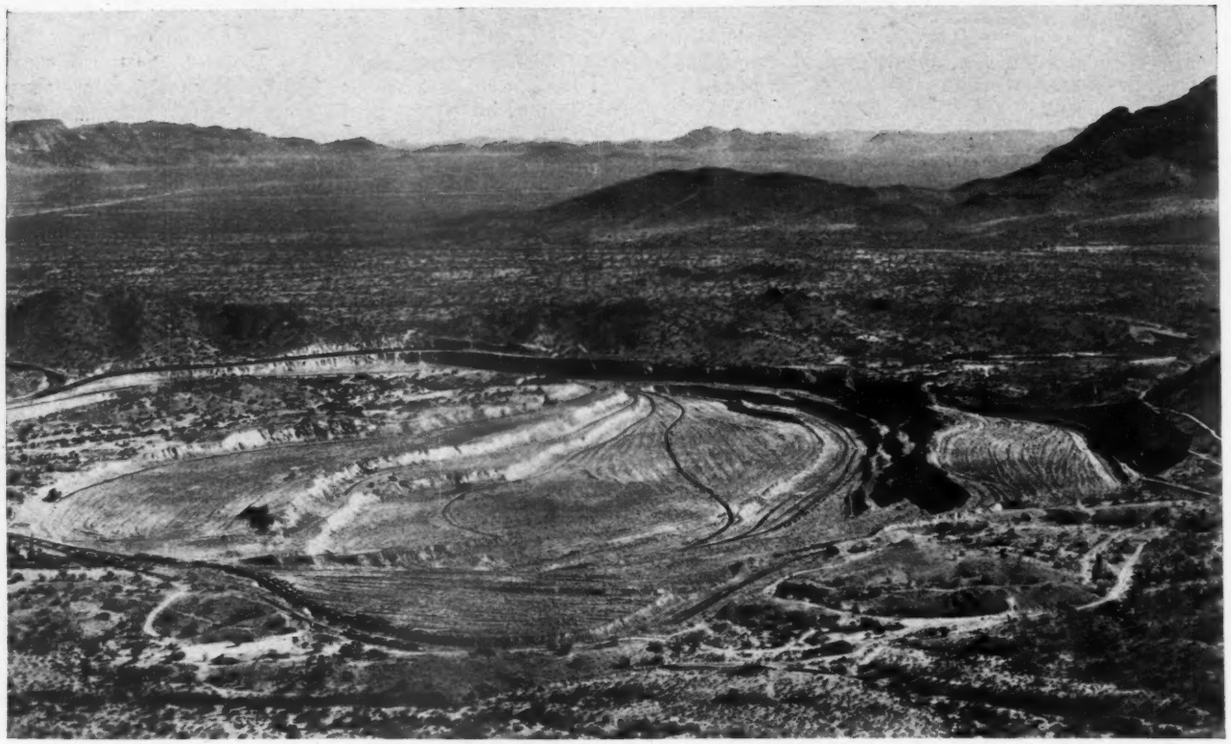
■

Anti-Climbing Guard Protects Motorman

IN CASE of derailment or wreck, serious injury to the motorman underground may be inflicted if no provision is made on the equipment to prevent the car next to the locomotive from climbing into the cab.

The accompanying illustration shows a locomotive equipped with anti-climbing guards. They consist of special castings bolted to the top of the bumper. One large mining company, according to *Coal Age,* has standardized on this safeguard and now has every one of its 263 electric locomotives so equipped.

Guard castings bolted to bumper



Open pit of the New Cornelia, at Ajo, Ariz.

Improvements at New Cornelia—I

George J. Young

Associate Editor

THE Ajo or New Cornelia enterprise of the Calumet & Arizona Mining Company started under the management of the late Col. J. C. Greenway and Dr. L. D. Ricketts, both men of great ability. Financing, engineering, and fulfillment of expectations were a source of inspiration to other managements. In 1916, a 5,000-ton leaching plant started production, and it has since continued in operation, with a record of some seventeen million tons treated. On Jan. 8, 1924, a sulphide concentrating mill of about 5,000 tons' daily capacity was placed in operation, and this mill has already treated about 14,500,000 tons. My colleague, A. W. Allen[1], has given an excellent account of the enterprise, and H. A. Tobelmann and J. A. Potter, as well as W. L. DuMoulin and Stewart Croasdale, have written about special features. H. Kenyon Burch[2] described the concentrating plant. In this article I will present details of present practice and describe in some detail the recent plant improvements.

During 1929 the concentrator handled 2,460,000 tons of ore, containing 1.278 per cent copper, and the leaching plant 1,122,031 tons, containing 1.056 per cent copper, and on the low-grade dumps were placed 384,063 tons of sulphide waste rock, containing 0.248 per cent copper, and 1,056,498 tons of carbonate waste rock, containing 0.248 per cent copper. Since the beginning of 1930 more or less curtailment in operations has been made.

The shallow open pit is elliptical in shape, about 7,500 ft. long and 3,500 ft. wide. Five benches approximating 25 ft. or more in height are developed, with two Osgood 105, 4-cu.yd. steam shovels on each bench. No change has been made in shovel operation, though the number of shovels has been increased from seven to ten. All are operated upon tracks. A lower pit approach is being cut. The pit admits of a convenient development of benches of sufficient length to permit systematic blasting and shovel operation.

Holes are drilled with Ingersoll-Rand N-72 Jackhamer, Denver 7, or CP 6 drills, all equipped with special blowing devices and handled by block and tackle ($\frac{3}{4}$-in. rope) and a portable three-leg tripod constructed of an 18-ft. length of $1\frac{1}{2}$-in. pipe. Excepting toe holes, practically all of the drill holes are vertical. Hollow round steel of $1\frac{1}{4}$-in. diameter is used; drill steel change, 2-ft. interval; gage change, $\frac{1}{16}$ in. Starters are 4 ft. long, with $2\frac{1}{2}$-in. bit width. One set of steel is usually required for a single hole, although sometimes three sets are necessary; this drill steel is delivered by a push car operated by the track shifter. Two men form a drilling crew and each drill accomplishes about 80 ft. of hole per eight-hour shift. Pro-

[1] "The Ajo Enterprise," *E.&M.J.*, Vol. 113, pp. 952, 1003, 1051; Vol. 114, p. 185.

[2] *E.&M.J.*, Vol. 118, p. 808.

vision has been made for fifteen drilling units. Angle or toe holes are required where bench slopes are not approximately vertical.

The standard bench height of 25 ft. was the outcome of experience in trying to get more or less uniform fragmentation, and to avoid large masses. Holes are drilled to a depth of 2 ft. below grade and are 15 ft. apart. The first line is from 5 to 10 ft. from the upper edge of the bench. The second row of holes is staggered with reference to the first row and three additional lines of holes are drilled at distances of 15 ft. apart, the holes being staggered with reference to neighboring lines of holes. Thus a bench area 225 ft. long and 90 to 100 ft. wide (including back break) will require about 100 drill holes, which is the average of one blast. A 30-ft. space is left between the next group of holes. Quarry Special No. 1 for dry holes, 40 per cent gelatine for wet holes, and 50 per cent gelatine for springing are the explosives used. Each hole is sprung two or three times and sometimes as many as six. Two electric exploders are used in each hole. Where the rock is very hard a second charge consisting of fifteen to twenty sticks (1⅛ in.) of 50 per cent explosive is placed halfway up in the hole above the stemming which is over the main charge in the bottom of the hole. Two primers are used in the bottom and one primer is used in the supplementary pocket. Exploders are connected in parallel to No. 10 insulated copper wire and are detonated by a power current. From an explosives ratio of 2.7 tons per pound of explosive, efficiencies were increased, until in 1927 the ratio was 4.22 tons per pound and in 1928 it reached 6 tons per pound.

The limit size of mine rock is whatever will pass the steam-shovel bucket. Oversize rocks are blockholed between trains. Each shovel is provided with one or two hand-held drills for this service, and nothing is cast aside. The bench is cleaned up within the swath of the shovel. Twenty-yard Kilbourne and Jacobs air-dump type ore and waste cars are used, and five five-car trains are operated on each shift. Shovels are

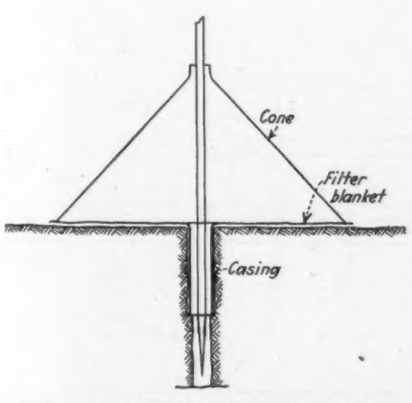


Fig. 1—Section of drillhole, showing sampling cone in place

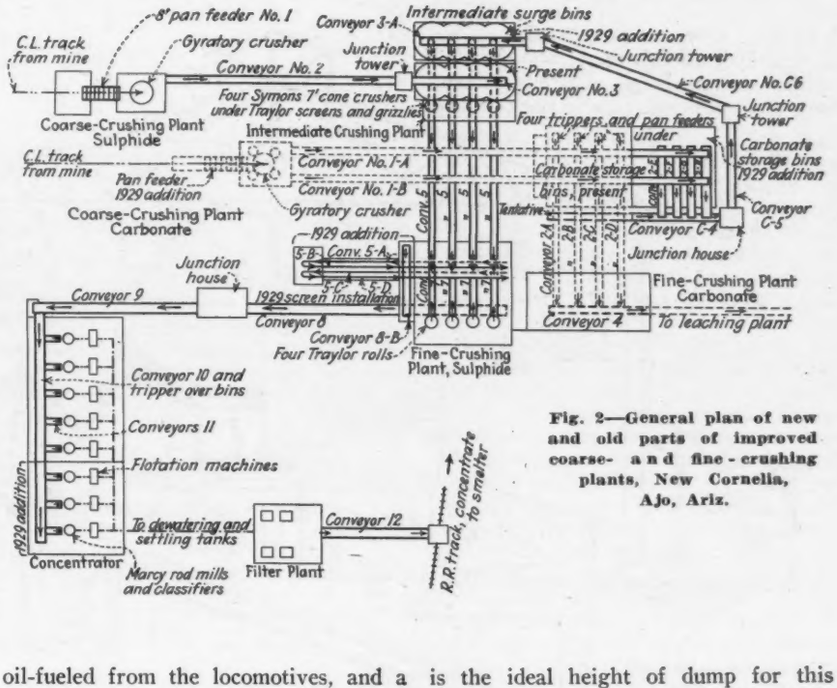


Fig. 2—General plan of new and old parts of improved coarse- and fine-crushing plants, New Cornelia, Ajo, Ariz.

oil-fueled from the locomotives, and a pipe system with hose connections supplies water.

Drill-sharpening and air compressor buildings are close to the entrance of the pit. A 6-in. air main connects to 4-in. pipe, and 2-in. branch pipes lead to the drills, each branch serving two drills. All pipe is on the surface. Three Sullivan angle-compound compressors, 1,500, 2,200, and 2,650 cu.ft. capacity, or a total of 6,340 cu.ft., supply compressed air for the pit operations, with 90-lb. air at the drills.

A satisfactory system of drillhole sampling has been developed, according to G. R. Ingham, the mine superintendent. A piece of 2½-in. pipe, 2½ to 3 ft. long, is used to support the collar of the drillhole. A discarded filter blanket is placed on the surface around the collar of the hole and a galvanized-iron cone 16 in. high and 30 in. bottom diameter is placed over the hole. The cuttings are blown out of the hole and deflected by the inner walls of the cone, Fig. 1, to the blanket. Samples are thus taken at 40-ft. intervals along each bank, and samples from one to four holes are combined, dependent upon the width of the bench to be blasted.

Seventy-pound rails are used throughout the pit. A track shifter is used and a Jordan spreader is used upon the waste dumps. The low-grade waste rock dump is winged out on either side of a median line, the main track connecting with right- and left-hand branches. As the loaded trains approach the point where each wing begins, the cars are dumped in sequence, the leading car at the "point" and the others in order, so that the locomotive never passes the point and the loaded cars always are upon firm ground, the end of each wing being held to high ground so as to avoid cribbing. Mr. Ingham expressed the view that 80 to 100 ft. is the ideal height of dump for this class of material and provides ample dump room.

Coarse-Crushing Plant

The new layout of the coarse-crushing plant is a clever piece of engineering, for the problem involved the utilization of existing structures and accessories so far as possible, and additional room was considerably restricted. Fig. 2 shows the respective parts of the new and old installations. Ore crusher storage-bin capacity was doubled, giving 10,000 tons. Carbonate ore bin storage was also doubled and provision made to use the coarse-crushing equipment for carbonate ore as auxiliary crushing capacity by providing a conveyor system discharging into the new addition to the sulphide intermediate surge bins as shown in Fig. 2.

Crushing of sulphide ore is accomplished in three stages: a 54-in. gyratory served by an 8-ft. pan feeder of all manganese-steel construction; four 7-ft. Symons cone crushers; and four sets of Traylor 78x24-in. rolls, operating in closed circuit with a screening plant. All manganese-steel pan feeders deliver the coarse ore from the intermediate storage bins to belt conveyors which discharge upon grizzlies and Traylor screens above the Symons cones, the undersize being bypassed to the conveyor receiving the crushed product from the Symons cones. All of the four conveyors from the cone crushers deliver to a 54-in. conveyor (5-A, Fig. 3), which discharge at a junction tower upon another belt conveyor (5-B, Fig. 4), which in turn discharges into the bins above the roll feeders of the screens. A battery of twenty-four 4x6 Hum-mer screens and eight Traylor vibrating screens (all ⅜-in.) arranged in two rows facing each other receives the ore from the screen

feed bin. Oversize is spouted to a 42-in. conveyor (5-C, Fig. 4) and elevated to the junction house, where it is sent by a 42-in. belt conveyor to the roll-feed bins. Stephens & Adamson trippers are used above both roll-feed and screen-feed bins.

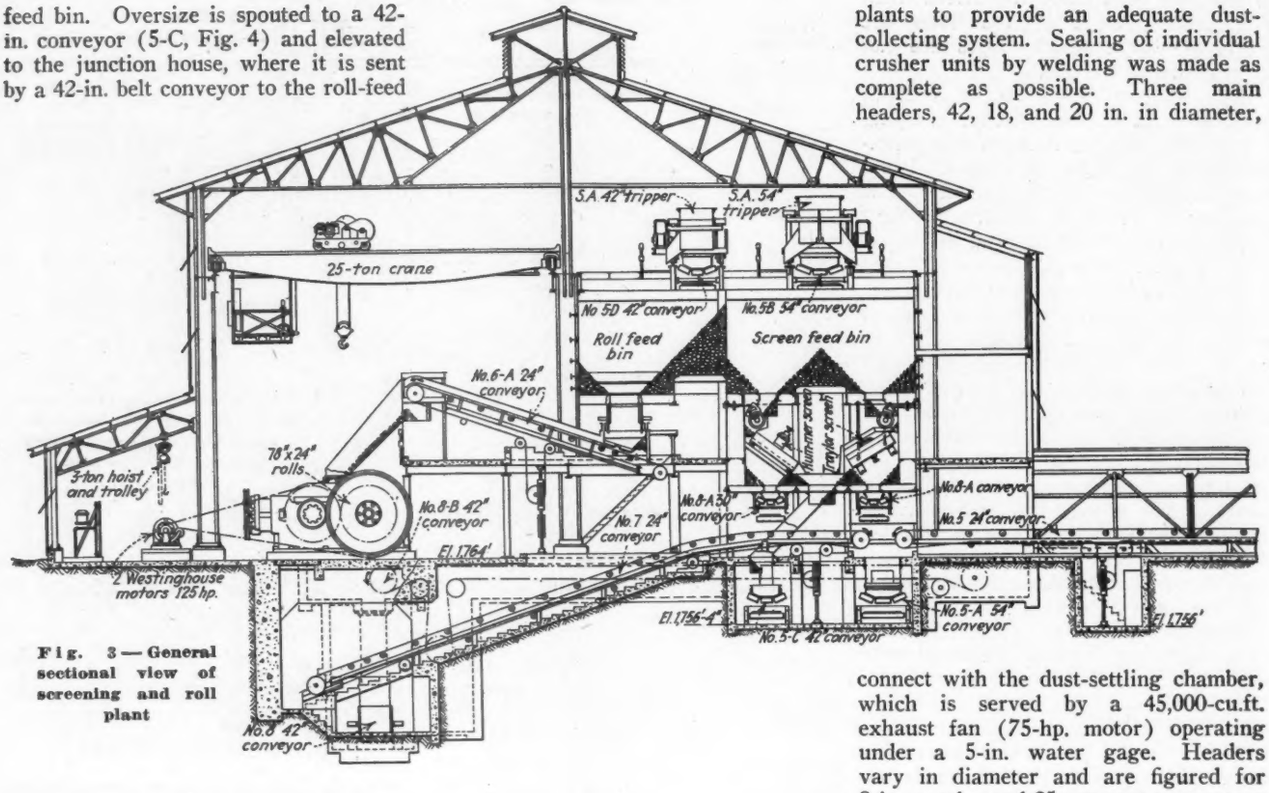


Fig. 3 — General sectional view of screening and roll plant

Twenty-four-inch inclined belt conveyors (No. 6-A, Fig. 3) receive the discharge from apron feeders and deliver to the rolls. The rolls are in closed circuit with the screens, the roll product being delivered by 24-in. belt conveyors (No. 7, Fig. 4) to conveyor 5-A, which delivers to the screen-feed bin. Screen undersize is gathered by two 30-in. conveyors (8-A, Fig. 3) which discharge upon a cross conveyor 42 in. wide, and this in turn delivers to conveyors Nos. 8, 9, and 10 (Fig. 2), arranged in sequence, by which it is delivered to the mill bins. The capacity of the coarse-crushing plant for two operating shifts is about 16,000 tons to 5 per cent on 4-mesh screen. Each of the four units has a capacity of from 200 to 250 tons per hour.

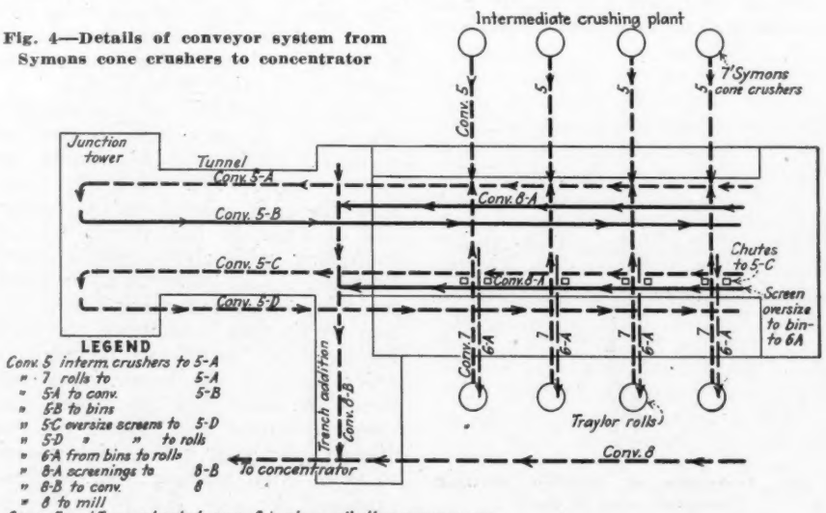
The motor sizes are as follows: 8-ft. pan feeder, 75-hp. induction motor; 54-in. gyratory, 350-hp. induction motor; 7-ft. cones, 250-hp. synchronous motors; rolls, two 125-hp. induction motors on each; 54-in. conveyor (No. 2, Fig. 2), 100-hp. motor; No. 3 conveyors (Fig. 2), 30-hp. motor each; feeder conveyor belts to cones, 7½-hp. motor each; conveyors under carbonate-ore bins, 2-E, 2-F, 2-G, 2-H, 10-hp. motor each; conveyor No. C-4, collecting conveyor below carbonate storage bins, 100-hp. motor; conveyor C-5, 100-hp. motor; conveyor No. C-6, inclined conveyor receiving from C-5 and delivering from carbonate-ore storage bin to intermediate surge bins (Fig. 2), 150-hp. motor; and conveyor 3-A, over intermediate surge bins, 30-hp. motor. In the screening plants No. 5 and No. 7 conveyors, 20-hp. motors; feeder belts to rolls, 6-A, 7½-hp. motors; pair of apron feeders driven by one 7½-hp. motor; four banks of eight screens each, screen roll feeders of each bank, 7½-hp. motor; conveyors 5-A and 5-B, 150-hp. motor each; conveyors 5-C and 5-D, 100-hp. motor each; conveyors 8-A, under screens, 25-hp. motor in each; conveyor 8-B, 15-hp. motor; conveyor 8 (to mill), 100 hp.; conveyor 9, 250-hp.; and No. 10 over mill bin, 100-hp. motor.

Dust-Collecting System

A special effort was made in the redesign of the coarse- and fine-crushing plants to provide an adequate dust-collecting system. Sealing of individual crusher units by welding was made as complete as possible. Three main headers, 42, 18, and 20 in. in diameter, connect with the dust-settling chamber, which is served by a 45,000-cu.ft. exhaust fan (75-hp. motor) operating under a 5-in. water gage. Headers vary in diameter and are figured for 8-in. nozzles and 25 per cent excess area over the branches entering the header. The 42-in. header serves screen discharge, screen oversize, and transfer points for crushed ore from rolls and Symons cones, two junction houses, feed to screens, and oversize to rolls; the 18-in. header serves feeders and conveyors to rolls; the 20-in. header serves roll discharges and transfer of finished material to mill. The dust-collecting chamber is of steel, 16 ft. outside diameter by 14 ft. high, and contains concentric baffles with water sprays at the first or inlet baffling ring. The collected sludge is caught in a concrete reservoir which overflows on the cross conveyor handling finished product from the screening plant.

Further details will be given in a subsequent article.

Fig. 4—Details of conveyor system from Symons cone crushers to concentrator



Conv's. 5 and 7 are relocated, conv. 8 in place, all other conveyors new

Borehole Facilitates Sinking of Shaft

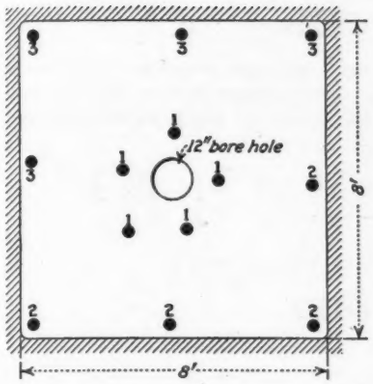


Fig. 1—Round used for drilling and blasting rock

RECENTLY when the Elk Horn Coal Corporation, which operates several mines in eastern Kentucky, found it needful to connect the advance working places in two of its mines with the outside, the general manager, G. M. Hay, and his staff devised a scheme of shaft sinking that is somewhat different from the ordinary method. This method is described by W. J. German in *Du Pont Explosives Service Bulletin* for April, 1930.

In each of these mines the workings had passed from under very heavy cover and reached a point beneath a ravine where the cover was approximately 100 ft.—90 ft. of sandstone overlaid with a shallow covering of earth. A location in the ravine directly over the mine workings was selected for a shaft, the ground was leveled off so that a well drill could be set up and a 12-in. borehole was drilled from the surface down into the underground workings, a 12-in. wrought-iron casing being used in the portion of the hole passing through earth. In the mine, tracks and switches were arranged so that mine cars could be spotted under the borehole by the gathering locomotive so that they might be loaded.

A crew of two men was then set to work on the surface to enlarge the borehole into a shaft 10 ft. square. By

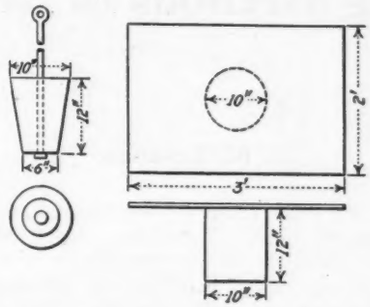


Fig. 2—Plug and templet used to prevent 12-in. borehole from becoming clogged

shoveling the soft earth down the hole and cutting the iron casing off with an acetylene torch from time to time, they excavated a shaft of the desired size down to the solid rock and timbered it in the usual manner.

When the rock was reached, a small portable air compressor, a jackhammer drill with a length of ¾-in. hose and a supply of steel bits, some picks, hammers, and bars, and a blasting machine and firing cable were provided. With this equipment and 40 per cent Red Cross extra dynamite and No. 6 electric blasting caps, secured as needed from the mine magazine, the two men drilled and blasted the rock and threw it down the center borehole.

To blast the rock, five holes were drilled from 4 to 5 ft. deep around the 12-in. hole and eight more around the sides of the shaft, as shown in Fig. 1. The five breaker holes, numbered 1, were fired first; then the four holes numbered 2; and then the remaining four. After each shot the broken rock was shoveled down the hole. The breaker holes were loaded with five cartridges each of 40 per cent dynamite and the other holes with four cartridges each. Most of the rock was broken small enough by the blasts to drop down the borehole easily, but to prevent this from becoming clogged the plug and templet shown in Fig. 2 were used. Before the five center holes were blasted, the 10-in. plug was suspended in the borehole at a depth just below the bottom of the jackhammer holes. After the blast, it was drawn up through the loose material, and, as soon as enough of the broken rock had been thrown down the hole to clear its top, the templet was replaced. As the opening in the shield was only 10 in. in diameter, this served to keep the hole from being blocked. Large pieces were pulled

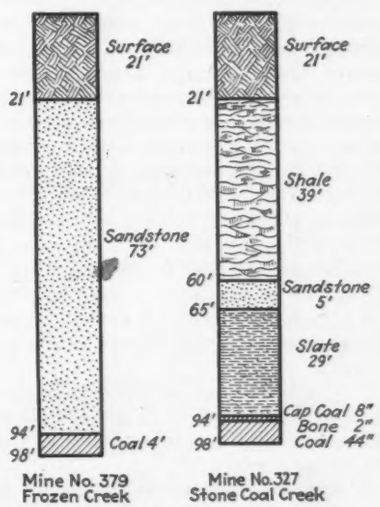


Fig. 3—Formations penetrated by boreholes

aside and broken with sledge hammers. When all the rock broken by the three shots of a round had been shoveled down, a new round of holes was drilled and the cycle repeated.

To prevent the material shoveled down the borehole from overflowing the car set beneath to catch it, a high-powered electric bulb was hung near the roof so that its light would shine past the hole. As long as the men in the shaft could see this light at the bottom of the hole they would throw material down, but when it was no longer visible, they would know that the material had piled up in the car so as to block the hole and they would then signal for the car to be changed for an empty one.

Mine car in drift below 12-in. borehole

The advantages of this method of sinking are that the 12-in. hole takes the place of a series of cut shots and always provides a free face for the center holes to break to; that it permits quick, easy, and economical disposal of the broken material; and that it serves to drain the shaft. Thus it does away with all need for loading, hoisting, and pumping equipment. The handling of the broken material and the drainage underground can be made a part of the regular mine operations at little additional cost. The labor cost for sinking the shaft is relatively low, and in general rapid progress can be made by this method.

Cost of Sinking Shaft on Stone Coal Creek, Mine 327, Garrett, Ky.

Size of shaft, in the clear		10x10 ft.
Inside the timbers		8x 8 ft.
Depth of shaft		95 ft.
Labor, including engineering		$3,149.90
Drilling		475.00
One 95-ft. 12-in. hole at $3.50	$332.50	
One 95-ft. 5⅛-in. hole at 1.50	142.50	
Lumber		483.70
Explosives		158.18
Teaming, tools and other supplies		229.41
Total cost		$4,496.19

Cost of Sinking Shaft on Frozen Creek, Mine 379, Wheelwright, Ky.

Size of shaft, in the clear		10x10 ft.
Inside the timbers		8x 8 ft.
Depth of shaft		94 ft.
Labor, including engineering		$2,536.42
Drilling		470.00
One 94-ft. 12-in. hole at $3.50	$329.00	
One 94-ft. 6-in. hole at 1.50	141.00	
Lumber		454.09
Explosives		202.14
Teaming, tools and other supplies		672.13
Total cost		$4,334.78

Cost of sinking this and another shaft belonging to the Elk Horn Coal Corporation, Wayland, Ky., is given in the two accompanying tables by G. W. Hay, general manager, who has also furnished the sketch of the logs of the two boreholes, shown in Fig. 3 on the preceding page.

Stoping Methods in Arizona

H. M. Lavender

THE average annual production of ore from the Warren mines of the Calumet & Arizona, largely mined by inclined cut-and-fill and semi-shrinkage methods, has been about half a million tons for the last two years. Average employment has been 940 men. The ore is almost entirely direct smelting, containing 5 per cent copper. It occurs in fissures and brecciated areas in limestone, which were intruded by granitic magma at the close of the Carboniferous period. So far, the greatest depth mined is 2,200 ft. The orebody as developed on the 1,600, 1,700, and 1,800 levels averages about 500 ft. long, and is from 50 to 250 ft. wide. The dip varies from almost 90 deg. to 25 deg. Most of the ore is chalcopyrite and bornite, in a pyrite, silica, and limestone gangue. The stoping requirements are briefly as follows:

1. The back must be able to sustain itself with a minimum of support when properly arched and trimmed over the area being mined.

2. Extraction must be complete in the section being mined.

3. The deposit must be homogeneous, reducing to a minimum any selective stoping in the section being mined.

4. As nearly as possible, all stopes or sections must be promptly and completely filled as completed.

The ore is hard, and heavy blasting is therefore necessary to prevent excessize formation of boulders.

Two vertical shafts serve the mine. The oval Campbell shaft is used for supplies and ventilation, and is being sunk to 2,350 ft.; and the five-compartment, 2,300-ft. concrete Junction shaft is the main hoisting, ventilation, and pumping shaft. Two other shafts aid the ventilation of the mine only.

The ground is hard, and 60 per cent gelatin is generally used for blasting drift rounds. Two classes of Leyner-type drifters are used, the light type weighing about 125 lb. and the heavy type about 185 lb. Hollow round steel 1¼ in. in diameter is used in all drifting operations.

Three general classes of raises are employed: cribbed, standard, and stull. Inclined cut-and-fill stopes are grouped in two general classes: (1) double leads (a line of square-sets along both sides of the section), which are subdivided into (*a*) fill raise in hanging wall and (*b*) fill raise in footwall; and (2) single lead and single cap. The cut-and-fill method of mining, with a modification called the semi-skrinkage method, is used exclusively in the Campbell area, and is described in detail. The semi-shrinkage method embodies less flooring expense than the cut-and-fill, and, owing to the longer cycle of operations, a better chance for specialization is offered, thus increasing labor efficiency. Its disadvantage lies in the additional care necessary in the final trimming of the back, and to the fact that the sets must be anchored to the solid. Also, more ore is tied up over a longer period, and waste demands are greater over a short period.

Trolley type, 3½-ton, 220-volt, d.c. locomotives are used on the main haulage levels and 1½-ton storage-battery locomotives on the intermediate levels for gathering. On the main haulage levels, 38-cu.ft. saddle-back side-dump cars, equipped with automatic couplers, are used. On the intermediate levels, 16-cu.ft. flat-bottom end-opening cars are used. Most of the cars have roller bearings.

Direct cost charges for a two-year period against all stopes in the Campbell area, and in the Campbell and Junction areas combined, follow. The tonnage represented from the Campbell area was 280,527, and from the combined areas, 1,033,111 tons.

Costs per Ton

(Per Cent of Total Cost in Parentheses)

	Campbell Area, Cents	Junction and Campbell Areas Cents
Labor	76.5 (60)	86.5 (65)
Explosives	12 (9½)	9.5 (7)
Timber	17.5 (13¾)	21.5 (16)
Air	22 (17)	16 (12)
Total	$1.28	$1.335

Brief abstract of U. S. Bureau of Mines Information Circular No. 6289, one of a series being prepared on mining methods, practices, and costs in various mining districts in the United States.

World's Gold Supply Soon to Dwindle

Present Twenty-Million-Ounce Yearly Production Likely to Drop One-Quarter in Next Decade—Important New Discoveries Improbable

H. A. Kursell

American Smelting & Refining Company, New York

WORLD gold production from 1493 to 1930, or since the discovery of America, has amounted to approximately 1,042,850,000 oz., of which about 555,350,000 oz., or slightly more than one-half, has been produced during the twentieth century. Of the total amount produced, roughly 500,000,000 oz., or about 48 per cent, is represented by monetary stocks, the balance of 542,850,000 oz. having been absorbed by industry, lost, or disappeared by hoarding.

Table I—World Production of Gold, by Years, from 1880 to 1930

Fine Ounces

Year	Production	Year	Production	Year	Production	Year	Production
1880	5,349,158	1893	7,543,737	1906	19,533,892	1919	17,667,308
1881	5,064,313	1894	6,657,113	1907	20,039,853	1920	16,335,420
1882	4,885,626	1895	9,518,192	1908	21,483,983	1921	16,003,616
1883	4,746,390	1896	9,716,749	1909	22,093,602	1922	15,467,223
1884	5,014,923	1897	11,396,952	1910	22,146,716	1923	17,802,109
1885	5,102,414	1898	13,920,747	1911	22,466,812	1924	19,033,459
1886	4,944,835	1899	15,073,419	1912	22,670,332	1925	19,025,942
1887	5,255,917	1900	12,420,942	1913	22,306,558	1926	19,349,118
1888	5,508,562	1901	12,692,227	1914	21,319,747	1927	19,397,757
1889	6,048,352	1902	14,494,382	1915	22,718,154	1928	19,674,638
1890	5,814,182	1903	15,934,268	1916	22,035,302	1929	19,675,000
1891	6,300,233	1904	16,902,209	1917	20,297,144	1930	19,675,000
1892	7,060,290	1905	18,488,085	1918	18,568,278		

Fig. 1, from U. S. Department of Commerce Economic Paper No. 6, 1929, shows the average annual world production of gold by decades, from 1801 to 1930. Figures for 1929 and 1930, which are not yet available, have been assumed to equal those for 1928.

Fig. 2 shows the distribution of gold production by continents, and Fig. 3 the political control of gold production. In 1929, the United States controlled 10.8 per cent of the world output and the British Empire 71.4 per cent. A further change in favor of the latter seems likely.

World production in 1928 was 19,674,638 oz. Of that total, 14,298,880 oz. was coined in that year, and 4,642,592 oz. was absorbed by industry in the main consuming countries for which reports are available.

The Transvaal output in 1929 amounted to 10,414,066 oz., or 53.1 per cent of the total world production, the record for this field.

Transvaal or Rand Production

The Rand gold deposits were discovered in 1885, and by 1899 gold production had risen to 3,637,713 oz. It declined to 348,761 oz. in 1900 owing to the Boer War. Its further development is shown by the figures in Table II.

Table II—Transvaal Gold Production

Fine Ounces

Year	Prouction	Year	Production
1905	4,909,541	1920	8,158,228
1910	7,527,108	1925	9,597,573
1915	9,093,902	1929	10,414,066

Table III compares ore reserves and grades in 1909, 1919, and 1929.

Attention is called to the number of mines that have ceased operations during the period between 1909 and 1929.

The large mines of the Rand are gradually attaining great depth. The

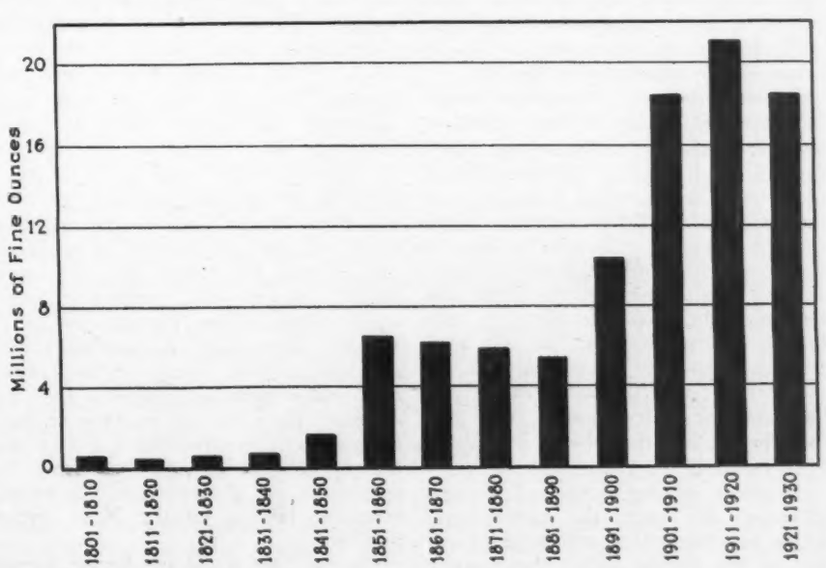


Fig. 1—Average annual gold production by decades

Table III—Rand Ore Reserves

In Long Tons

	1909		1919		1929		Stoping Width, Inches
Aurora West	339,000	$5.85	.....	....	.....	....	.....
Bantjes Conso.idated	958,440	7.60	.....	....	.....	....	.....
Benoni Consolidated	606,117	6.47	.....	....	.....	....	.....
Brakpan Mines	1,720,181	6.56	2,484,000	$8.79	2,531,440	$7.89	57.61
Cinderella Consolidated	421,884	6.78	.....	....	.....	....	.....
City Deep	2,273,187	8.20	3,418,050	9.4	1,809,000	6.31	51.2
City Suburban	828,936	6.88	.....	....	.....	....	.....
Cons. Langlaagte	401,317	6.37	2,090,300	6.25	.....	....	.....
Cons. Main Reef	.....	....	1,200,900	7.5	1,985,700	7.5	41.7
Crown Mines	6,282,719	7.60	8,451,400	6.3	10,841,460	6.66	46.4
Durban Roodeport Deep	867,551	6.70	1,077,500	6.6	2,059,300	7.28	43.3
East Rand Prop. Mines	.....	....	2,634,350	6.3	3,414,270	6.3	55.0
Ferreira	598,671	8.10	.....	....	.....	....	.....
Ferreira Deep	1,779,328	9.60	807,880	8.2	.....	....	.....
Geduld Proprietary	44,600	9.09	2,580,000	7.4	6,100,000	6.5	60.0
Geldenhuis Deep	2,521,481	6.10	1,375,200	5.9	760,300	5.66	55.6
Ginsberg	341,207	6.50	.....	....	.....	....	.....
Glencairn	1,120,607	4.00	.....	....	.....	....	.....
Government Areas	.....	....	11,001,700	8.6	10,973,000	8.9	65.0
Jupiter	1,074,000	5.80	.....	....	.....	....	.....
Knight Central	700,000	6.00	.....	....	.....	....	.....
Knights Deep	1,700,000	5.50	997,000	4.8	.....	....	.....
Langlaagte Est	1,267,769	....	1,002,400	6.5	1,567,500	7.1	42.0
Lancaster West	431,000	6.76	.....	....	.....	....	.....
Luipaardsvlei Est. & G. M. Co.	.....	....	.....	....	924,300	5.4	42.3
May Consolidated	300,475	....	.....	....	.....	....	.....
Meyer & Charlton	249,326	8.60	.....	....	43,301	5.1	42.0
Modderfontein B	2,788,000	7.00	3,215,100	9.0	1,445,400	7.3	51.0
Modderfontein Deep	.....	....	3,775,000	9.1	3,008,000	8.9	79.0
Modderfontein East	.....	....	850,000	8.0	2,045,400	6.1	46.5
New Modderfontein	2,581,744	7.10	8,854,300	8.5	9,097,600	8.6	50.0
New Goch	741,688	5.43	.....	....	.....	....	.....
New Kleinfontein	1,397,412	6.46	2,312,000	5.53	531,000	4.9	54.0
New Heriot	485,585	8.41	.....	....	.....	....	.....
New Primrose	490,809	7.80	45,500	6.4	.....	....	.....
New State Areas	.....	....	.....	....	2,678,000	8.7	51.0
New Unified	285,174	6.80	149,000	6.5	.....	....	.....
Nourse Mines	2,142,047	6.50	1,526,100	6.8	1,266,700	5.9	43.0
Randfontein Central	6,573,637	....	3,802,000	6.3	.....	....	.....
Randfontein Estate	.....	....	.....	....	4,196,800	5.8	42.0
Roodepoort United	617,735	5.47	.....	....	.....	....	.....
Rose Deep	3,553,474	6.10	3,031,280	5.2	714,300	4.8	65.0
Robinson	1,444,189	11.77	115,200	....	.....	....	.....
	2,202,437	4.24	.....	....	.....	....	.....
Robinson Deep	1,050,000	7.23	1,583,000	6.59	1,307,000	6.0	60.0
Simmer Deep	1,255,000	5.01	836,000	5.1	.....	....	.....
Simmer East	950,000	5.40	.....	....	.....	....	.....
Simmer & Jack	2,690,000	6.30	.....	....	1,581,000	5.9	48.0
Springs Mines	.....	....	.....	....	3,250,238	9.3	52.5
Sub Nigel	.....	....	342,000	10.3	922,000	18.0	22.0
Van Ryn Deep	.....	....	3,200,000	9.1	3,110,700	7.4	50.0
Van Ryn Estate	.....	....	1,287,520	5.7	1,323,976	4.5	.....
Village Deep	1,943,593	6.10	2,389,700	6.3	1,544,600	5.7	54.4
Village Main Reef	1,775,175	....	.....	....	.....	....	.....
West Rand Cons	1,124,631	5.54	.....	....	3,502,000	5.6	49.0
West Springs	.....	....	.....	....	2,752,680	6.34	61.16
Witwatersrand	.....	....	.....	....	647,300	6.2	.....
Wit. Deep	1,232,784	5.78	1,142,500	5.9	617,078	6.0	.....
Wolhuter	759,969	6.41	693,894	5.7	.....	....	.....

maximum in 1925 was 6,300 ft. vertically below surface. By June, 1930, the Village Deep, for instance, will have reached a vertical depth of 7,640 ft. Further extension of workings in depth must be considered extremely remote. Among the factors which increase the difficulty of working mines at increasing depth are hoisting, rock pressure, and temperature. The most critical of these at present is the increase of temperature with depth.

Whereas the normal temperature rise is considered 1 deg. F. for 219 ft. of vertical depth, the corresponding figure for the Rand is 1 deg. for every 254 ft. of vertical depth. The probable rock temperature at 8,000 ft. vertically below surface therefore will be 100 deg. F. Experience has shown that it is not possible to keep the temperature at the bottom of the intake where the air is split to the several workings at less than 10 deg. below the temperature of the virgin rock; in drifts, main raises, and haulageways, at less than 7 deg.; and in stopes at less than 4 deg. below the temperature of the virgin rock.

At about 80 deg. saturated air and 100 deg. dry bulb, the approximate limits are reached of successful operation of the human body's thermostatic control when at work. Increased air circulation at high temperature, particularly if above body temperature, only adds to the discomfort. Amelioration of conditions can be obtained by lowering the moisture content of the air. Dehumidifiers have been tried in several places and refrigerating units are being used with some success for the lower levels of the Morro Velho mine of the St. John del Rey Mining Company, in Brazil, where on the lower levels (7,500 ft.) the temperature had reached 120 deg. with 60 per cent moisture. The Morro Velho, however, is a relatively rich mine (ore reserves in January, 1929, were 1,171,537 tons assaying $14.58 gold per ton), whereas the Rand mines exploit ore assaying $6.59 per ton and yielding a profit of only around $2, which does not leave much margin for expensive air-conditioning. The rigorous Miners' Phthisis regulations demanding abundant use of water sprays in the Transvaal make dehumidifying of the air difficult. By a change in these regulations a slight improvement might be obtained. Nevertheless, 8,000 ft. may be considered the ultimate depth to which economic mining on the Rand seems feasible.

On the East Rand the banket forms a syncline, dipping more flatly here (30 deg.) than in the Central Rand, and some of the mines (Brakpan, for instance) are working at a depth of 20,000 ft. along the dip below the outcrop. A maximum vertical depth of 6,000 ft. seems likely here for geological reasons.

As regards the "known" Rand—that is, the area comprising the 36 mines now producing, Dr. Pirow, South African Government Mining Engineer and president of the South African Geological Society, stated in his presidential address in August, 1929, that the estimated reserves of probable tonnage in the Rand were 320,000,000 tons, and he allowed for prospective tonnage in undeveloped areas of 180,000,000 tons of possible ore.

In addition hereto, according to a statement by Sir Robert Kotze made in the South African Assembly early in 1930, about 440,000,000 tons of rock is estimated to exist, containing 3.50 to 4.50 dwt. (or $3.50 to $4, figuring gold at $20 an ounce) per ton, which is not at present workable. Average working costs in 1929 were 19s. 10d., or $4.82, compared with 18s. 6d. ($4.50) in 1913. That this rock can be made commercially exploitable seems therefore rather remote.

The 36 producing mines on the Rand milled 31,044,600 long tons of ore in 1929, yielding 0.3396 oz. per long ton. Average yield in 1917 was 0.3300 oz. per long ton, which indicates a marked regularity of grade.

The average width of the banket is from 4 to 4.5 ft. (maximum average for individual mines, 79 in.; minimum, 22 in.). Therefore, to produce the tonnage mentioned in the foregoing, roughly 90,000,000 sq.ft., or 2,250 acres, of productive reef area will have to be stoped annually, and there are sections where the reef pinches or is below commercial grade. This figure illustrates the scale of operations which will exhaust in measurable time even a deposit that is known for over 80 miles along the strike.

A. Lewis, in the *South African Mining Review* (November, 1929), esti-

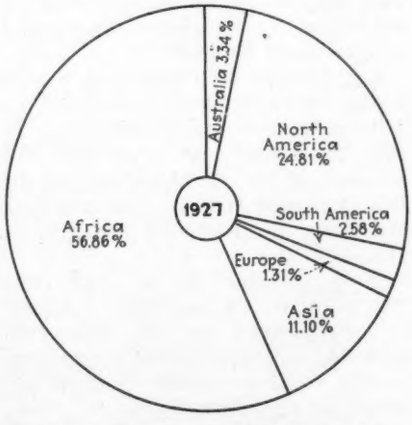


Fig. 2—Present distribution of gold production by continents

mates the life of the various Rand mines as follows:

Mine	Years of Life
* Brakpan Mines	16 to 25
* City Deep	20 to 25
* Consol. Main Reef	14 (At least)
Durban Deep	15 to 25
* E.R.P.M.	20 to 30
Geduld	13 to 20
Geldenhuis Deep	4 to 8 (Possibly even 10)
Government Areas	15
Langlaagte Estate	10 to 14
Luipaardsvlei	20 (Probably)
* Meyer & Charlton	(A few years)
Modder B	7 to 9
Modder Deep	8 to 10
* Modder East	12 (Possibly much extended)
* New Kleinfontein	(Properties can be worked by other companies)
New Modder	14 (Possibly a further few years on low-grade ore)
New State Areas	15 to 17
* Nourse Mines	14 to 18 (Further areas obtainable)
* Randfontein Estate	14 to 18 (Even over 30 possible)
* Robinson Deep	14 (Amalgamation with Village Deep would help both companies)
* Rose Deep	5
* Simmer & Jack	12 (And over)
* Springs Mine	12
* Sub Nigel	24 to 30
* Van Ryn Deep	10
Van Ryn Estate	(May yet live for some years)
* Village Deep	5 to 7
* West Rand Consol.	(Well over 30 years probable)
* West Springs	9 to 20 (or more)
Witwatersrand	(A few years more)
Witwatersrand Deep	5 to 7

* Companies that can secure more claims and life.

As in every great mining field, optimists see vast possibilities for an extension of the Rand, particularly in the east beyond the present Far East Rand mines, and likewise to the west. The consensus of more balanced opinion, however, seems to be that if the Rand mines continue crushing on an annual basis of 30,000,000 to 32,000,000 tons, the Rand production will remain more or less stable around 10,000,000 oz. for the next four to five years, but by 1936 a decline of 30 per cent is to be expected. Sir Robert Kotze, engineer for the South African government, estimates a decline of 48 per cent by 1936, which is likely to increase gradually, as the present probable and prospective ore reserves will be exhausted by about 1947.

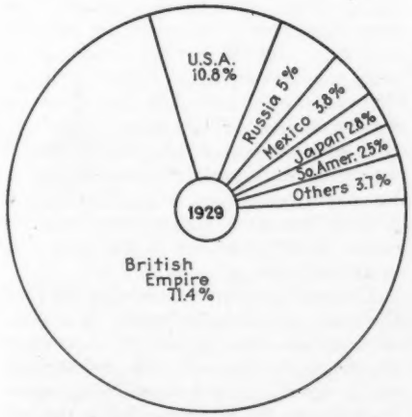


Fig. 3—Political control of 1929 gold production

Although the Transvaal is likely to continue as an important gold producer even after 1950, its contribution to world production will be on a much smaller scale than heretofore.

United States

The United States, with 10.8 per cent in 1929, ranks as the second gold producer of the world. Its production has steadily declined since 1915, when it reached its peak with 4,823,672 oz., to 2,128,027 oz. in 1929.

Of the 25 largest producers listed in 1927, six had practically suspended operations at the beginning of 1930. Homestake, in South Dakota, remains the premier gold mine in the United States, milling about 1,600,000 tons per annum and recovering $3.65 to $3.75 gold per ton. Reserves of the property are estimated at around 16,500,000 tons.

The fact that no new large gold mines (Fairbanks excluded) have been developed in Alaska in the last decade has caused general disappointment. It seems likely that the United States will maintain its production around 2,000,000 oz. per annum for some time to come. No appreciable increase is expected.

Canada

Canada, whose production has increased from 773,178 oz. in 1914 to 1,914,920 oz. in 1929, is likely to wrest second place as a world producer from the United States in the near future. It may possibly attain a production of 2,500,000 to 3,000,000 oz. per annum. However, the output of the largest Canadian gold field, Porcupine, is declining. The production of the Hollinger mine declined in 1929 from $11,000,000 to $9,000,000. Ore reserves for this property, on Dec. 31, 1927, were given as 4,789,438 tons assaying $9.89 per ton. McIntyre ore reserves, in December, 1928, were given as 1,546,754 tons assaying $8.45 gold per ton. Dome seems to be nearing its end. Wright-Hargreaves and Kirkland Lake gold mines do not publish figures on ore reserves.

Russia

Russia, contributing about 1,000,000 oz., or 5 per cent of the world total, holds fourth place as a gold producer. It has recently become the fashion among people interested in the future outlook of gold production to credit Russia with vast potentialities. The U. S. Bureau of Mines, Economic Paper No. 6, published in 1929, summarizing on page 62 the outlook for future gold production, speaks of Russia's "vast unexplored and undeveloped precious metal resources." The last issue of "The Mineral Industry" (1928), a standard handbook, quotes on page 242 Boris P. Torgasheff in *The China Weekly Review*, March 9, 1929, stating that the Russian Far East contained untapped gold reserves exceeding 6,000,000 kg. (193,200,000 oz.) and northern Manchuria, 3,500,000 kg. (112,700,000 oz.). Such statements have no foundation in fact and probably would not be made if those responsible for them were better acquainted with the original language and with the mineral nature of the country of which they speak.

Russia has been, and to some extent it still is, the placer country par excellence. Less than 10 per cent of its production has come from lode mines, all of which are small. The placers, on the whole, were likewise small, shallow, but fairly high grade—that is, pre-eminently suited for mining operations on a small scale. Individuals or small groups of individuals working entirely without capital, chiefly as lessees or tributors, produced even in 1912 62 per cent of the total Russian gold output (1,880,100 oz.). Of Russian production, the major part (77 per cent) came from eastern Siberia. The largest gold mine in Siberia, believed to have been the largest and richest placer mine in the world, is the Lena Goldfields. The rich and deep channels for which Bodaibo was famous ($16 to $20 per cu.yd.) have mostly been exhausted. Ore reserves in 1928 were estimated at 110,000,000 cu.yd. of dredging ground, valued at 36.6c. per cubic yard. Incidentally, it may be mentioned that C. W. Purington, in 1916, estimated the available dredging ground at 324,172,800 cu.yd. Allowing for undeveloped and unprospected areas, the expected optimum for this district might be 500,000,000 cu.yd., containing perhaps 10,000,000 oz. gold.

There are some dredging possibilities, though on a small scale, on the Zeya River and other tributaries of the Amur, in the Yenissei basin, and in the Maritime Province; but the vast majority of placer ground in the Urals, the Tomsk and Semipalatinsk districts, and in the Far East, contained only shallow and small deposits, most of which have been exhausted.

Russia's gold production will probably remain around 1,000,000 oz. per annum for a considerable time, but no expectations of a large increase, sufficient to influence world production, are warranted. Russia has been much more thoroughly prospected and its mineral resources are much better known than is generally thought.

Other Countries

A study of the gold mines and prospects in the other gold-producing countries—that is, Mexico, Central and South America, Australia, New Guinea, Rhodesia, West Africa, British India, Japan (including Korea), and China—reveals the fact that no appreciable increase in world production can be expected.

With the exception of the Transvaal (10,414,066 oz. in 1929), Canada (1,914,920 oz. in 1929), and Japan (507,000 oz. in 1927), gold production

in most countries has been steadily declining as shown in the following tabulation:

	Ounces Produced	Year	Ounces Produced	Year
Rhodesia	652,791	1922	560,813	1929
West Africa	419,510	1914	175,100	1929
Western Australia	553,833	1921	377,164	1929
India	541,086	1916	363,271	1929
Mexico	1,205,000	1910	725,175	1927

This does not indicate, however, that no new large and profitable gold mines will be found in these countries. The contrary is quite possible. A certain revival of gold mining is expected in Australia; lode and placer mining seems promising in New Guinea; and production in South America is likely to increase within the next few years, though it is generally held that exploration in the Andes has progressed to a point which suggests the probability that no large gold mines are to be found there.

Nevertheless, it may not be amiss to point out that the opening up of a few new large mines, be they even another Lena Goldfields (500,000 oz. per annum), a second Hollinger (450,000 oz. per annum), or Homestake (300,000 oz. per annum), would not appreciably alter the picture of the future outlook for world gold production, which is controlled by the output of the Rand.

The following figures show ore reserves and grade of leading gold lode mines outside the Rand:

	Tons	Grade
Hollinger (Dec. 31, 1927)	5,789,438	$9.89
McIntyre (Dec. 1928)	1,546,754	8.45
Morro Velho (Jan., 1929)	1,171,537	14.58
Ashanti Goldfields Corp., West Africa (Sept. 30, 1929)	590,200	25.20
Cam & Motor, Rhodesia (June 30, 1929)	1,260,500	12.70
Mysore Gold (India), 1928	569,617	10.00
Chosen, Korea (June, 1929)	200,000	7.57

New Discoveries

Discovery of new large gold fields becomes less likely with every year. Gold has been coveted by mankind for thousands of years and is more easily found in nature than other metals. It occurs mainly associated with quartz or silicified rocks which withstand erosion more readily than inclosing formations. Gold deposits, therefore, so far as they have not been eroded, are likely to outcrop on the surface. In places where they do not outcrop, quartz float is usually found, being more permanent than other rock débris. Gold, because of its chemical and physical qualities, is nearly indestructible, and traces of it in river sand, gravel, and soil will lead the prospector to its source. If the original vein has been eroded, the gold content, because of its specific gravity, will tend to concentrate in stream or river beds and form the so-called placer deposits.

The chances of discovering new gold deposits by geophysical prospecting are not promising. These methods are based upon differences in electrical conductivity or specific gravity. Therefore it is readily apparent that they are much more applicable to bodies of massive sulphides than to quartz deposits containing quantitatively insignificant amounts of gold or of the base metal sulphides.

The world has undoubtedly been more thoroughly prospected for gold than for any other metal. Even in ancient Egyptian times mining for gold extended through northern Africa probably farther south than Abyssinia, as well as in the Arabian peninsula. It has been the principal object of search by adventurous prospectors throughout the ages, especially in placer form, because—

(*a*) Placer gold is easily traced through panning along streams.

(*b*) Placer deposits are easily worked by the individual, without the necessity of much machinery other than shovels, picks, and roughly made sluice boxes.

(*c*) The results are readily concentrated into a small bulk and so made portable for long distances by man or beast in countries without roads.

The placer fields of California were discovered and worked when that country was little known otherwise, as were also the placers of Montana. Placers of the frozen North (the Klondike and Nome districts), of Siberia, with an equally frigid climate, as well as those in the hot desert areas of Australia all indicate the intensity and success with which placer deposits of gold have been sought and worked in the most inaccessible and climatically unfavorable parts of the world. Although large placer deposits may conceivably remain, after mankind's search for thousands of years and especially after the intensive exploration of recent generations, the probability is that few spots of the earth are left which have not been carefully explored and investigated. As above stated, gold mines other than placer are found in quartz, which, being harder than most rock substances, has made it possible to find quartz deposits because of their prominence in the surrounding country.

The Rand itself was discovered in 1885, and one has only to recall the surrounding conditions of savage tribes and trackless wastes in that country at that time to realize the difficult conditions under which gold is discovered, so strong has been the lure in its search. Since the War, Africa has been intensively prospected. The airplane has played its part there, as in Canada and elsewhere, in establishing distant bases from which prospecting takes place in otherwise inaccessible portions of the world. With the possible exception of desert areas in Australia, Central Asia, and around the Sudan, and those tropical areas at the head waters of the Amazon and Orinoco rivers, which so far have been almost inaccessible because of the hostility of the native tribes and the nature of the climate, few portions of the earth's surface have not been subjected to man's eager search for gold. When one reflects upon the long duration and intensive character of this search, one may quite properly conclude that the chances of discovery of new gold mines of magnitude are much less than is generally supposed, even by economists and other students who are likely to conclude that because the last century has seen the discovery of one gold field after another (California, Australia, the Rand, Klondike, Lena), the process can and will go on indefinitely. The mining engineer knows that such is not the fact, although it is still possible, even if not probable, that important discoveries may yet be made.

Summarizing the foregoing it would appear that world gold production will remain stable at around 20,000,000 oz. during the next few years until not later than 1935, when a slow decrease will probably begin, bringing world production to about 15,000,000 oz., by 1940.

Notwithstanding the fact that more than half of the world's gold production has been coined in recent years, it is generally estimated that not more than about half of the world's annual production is available for currency and banking purposes, since gold disappears through hoarding and through consumption in the arts.

No reduction of consumption for industrial purposes is to be expected. In fact, changes in fashions for jewelry and expanding needs for the arts are likely to increase this demand. And as this demand will be supplied first, it follows that any reduction in world production will reduce, not proportionately but equally, the new gold available for banking and currency purposes. It seems logical to expect that between 1935 and 1940 the available gold supply for the latter purpose will not exceed 5,000,000 to 6,000,000 oz. per annum, or about half of what it is at present.

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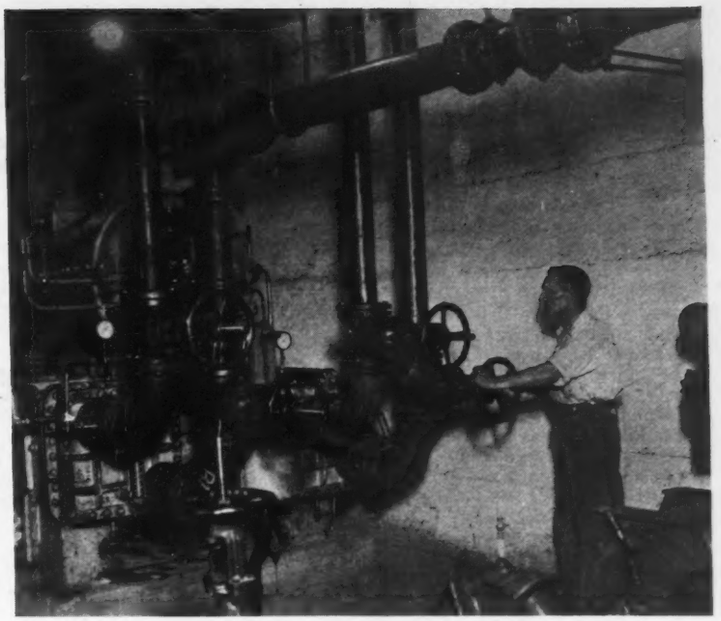
Coal Dust for Mold Surfacing

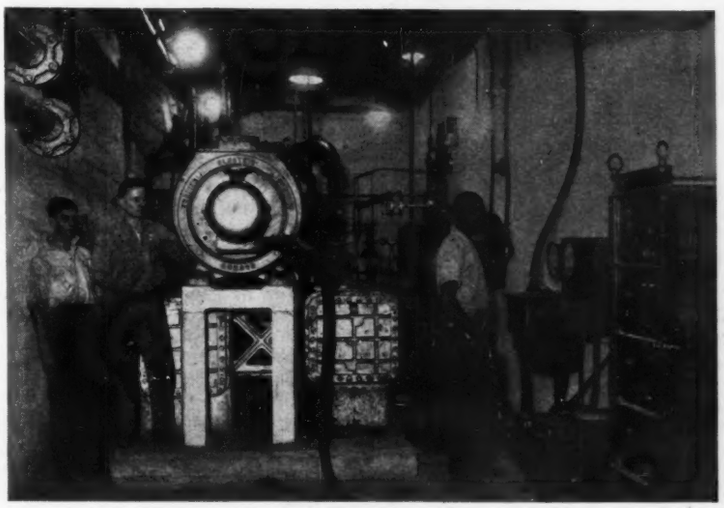
A NEW mixture of materials for spraying casting machine molds is used at the U. S. Steel Corporation's plant at Ironton, Utah. The material used for spraying the cast-steel molds is of a dark gray color, as compared with the white lime generally used at other plants. By using a special mixture consisting of about 75 per cent fine coal dust and 25 per cent lime, mixed with a corresponding amount of water, the company's lime bill has been cut almost in half. Tests were made with coal dust and water only, which worked satisfactorily during the day shift but hampered operations at night, making it difficult for the operator to spray the chills properly because of the dark color of the mixture.

The coal dust is obtained directly from the crushing plant by means of a small suction fan drawing off the fine material from the hammer mill and depositing it into a closed sheet-iron hopper. A discharge door is provided at the bottom of the hopper to facilitate the sacking of the coal dust.

Deepest Mine in Americas Adopts Air Conditioning



William Hasselman, of the Carrier company, supervises the preliminary tests

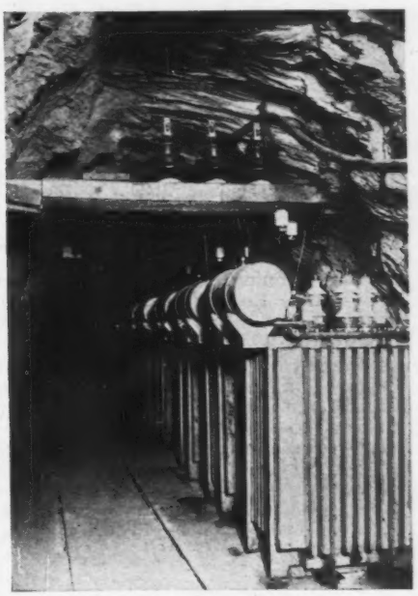


Cooling plant, surmounted by motor, 5,826 ft. below surface, in Morro Velho mine

DEHUMIDIFICATION as well as cooling are now effected in the lowest levels of the Morro Velho mine, in Brazil, by means of the Carrier plant illustrated herewith, the construction of which was recently completed. An ammonia cooling plant, used since 1922 to reduce temperatures in the mine from the surface to the 6,000-ft. level, will continue operation, the Carrier system supplementing it to correct air conditions below that level. Normal rock temperatures at the lowest levels of the Morro Velho mine are about 130 deg. F., giving an air temperature of about 126 deg. F.

The Carrier plant operates as follows: A fan withdraws air at the rate of 26,000 ft. per minute, 60 per cent of which is passed through water maintained at a temperature of 49 deg. F. by the use of cooling apparatus employing the principle of alternate expansion and compression of a gas, as used in domestic refrigeration units. The cooled air is then dried by being passed through special vanes. Leaving the Carrier plant at about 70 deg. F., this portion of the air then mixes with the remaining 40 per cent of air forced down the mine, proceeds to the lowest levels, and returns up through the stopes and winzes. Tests show that a 90-deg. temperature may now be maintained at the bottom of the mine, although it will be a few months before rock temperatures will have decreased correspondingly. Another 15-deg. reduction in temperature with the existing equipment is possible, although this will not be desirable until after the workers have becomes acclimatized to the new conditions.

A feature of the new equipment is the absence of hazard factors. Comfortable working conditions result. The drying process, a part of the Carrier system, reduces the excessive humidity of the air normally characteristic of deep mines. The installation is operated by two 125-hp. motors.



Underground transformer station for cooling plant motors

Digest of Current Technical Literature

Selected from abstracts of articles in the leading technical periodicals, prepared by Engineering Index Service, American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y.

Clay Products Manufacture—Structural Clay by a New Process, J. B. Shaw and M. C. Shaw. *Arch. Rec.*, Vol. 67, No. 4, April, 1930.

ABSTRACT of paper delivered before Am. Ceramic Soc., previously indexed from *Brick and Clay Record*, Feb. 25, 1930—E.I.S., New York.

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Phosphate Mines and Mining: Materials Handling—Heavy Handling Characteristic Superphosphate, M. Barclay. *Chem. and Met. Eng.*, Vol. 37, No. 4, April, 1930.

DESCRIPTION of handling methods from mines to point of final distribution used by Davison Chemical Company, Baltimore, Md.—E.I.S., New York.

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Salt Industry: Russia—Salt Deposits and Salt Industry of Turkmenia. Y. K. Davidov. *Gorniy Journal*, Vol. 105, Nos. 8 and 9, Aug. and Sept., 1929.

DESCRIPTION of salt mines and brine lakes east of southern half of Caspian Sea and along Afghanistan border of Russia; chemical composition of brines; statistical data on salt production; features of salt making methods; prospects of industry. Bibliography. (In Russian.)—E.I.S., New York.

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Precious Stones: Russia — Gems and Precious Stones in the Soviet Republic, A. Fersmann. *Zeit fuer Praktische Geologie* (*Halle*), Vol. 37, No. 12, Dec. 1929.

GENESIS and geographical description of deposits of precious stones, present condition of mining, value of mined stones are tabulated; import and export value of precious stones in 1905, 1910, 1913 and 1923-1925; economical market outlook.—E.I.S., New York.

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Beryllium—Beryllium. *Foundry Trade Jl.*, Vol. 42, No. 708, March 13, 1930.

TRANSLATED abstract of leaflet from Louis Hamburger & Company, Berlin, which summarizes properties of beryllium and some of its alloys.—E.I.S., New York.

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Copper Refining, Electrolytic: Ontario —Ontario Refining Company, E. D. Loney. *Can. Min. Jl.*, Vol. 51, No. 13, March 28, 1930.

DESCRIPTION of plant under construction of Copper Cliff, first of its kind in eastern Canada and largest in British Empire; building construction; tank-house equipment; power supply from High Falls plant of International Nickel; separate unit for precious metal recovery from slimes; some Canadian employees to be trained at plant of United States Metals Refining Company at Chrome, N. J.—E.I.E., New York.

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Mine Hoists: Electric—Forced Ventilation Raises Safe Rating of Mine Hoists, C. Lee. *Coal Age*, Vol. 35, No. 3, March, 1930.

DESCRIPTION of duplicate electric shaft hoists at Kincaid mines of Peabody Coal Company, Tovey, Ill.; Ilgner Ward Leonard type, rated 675 hp., 550 volts, 65 r.p.m., and flywheel set 550 kw., 694 r.p.m.; rating of hoist was based on rise of 49 deg. C. above room temperature of 25 deg. C.; in original installation, natural circulation was depended upon for cooling equipment; increase in capacity of plant made it necessary to increase cooling facilities by installation of blower supplying 7,000 cu.ft. of air per minute.—E.I.S., New York.

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Copper: Railroad Transportation—New Methods of Shipping Copper Save Thousands Annually, R. H. Ewry. *Matls. Handling and Distribution*, Vol. 4, No. 1, April, 1930.

DESCRIPTION of proper loading of copper in freight cars; savings effected by use of copper storage rack.—E.I.S., New York.

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Iron Deposits—World Iron Ore Supply Is Apparently Without Limit, C. Hart. *Iron Trade Rev.*, Vol. 86, No. 15, April 10, 1930.

STUDY of researches of geologists; latest estimates place actual and potential reserves of world at more than 175 thousand million tons.—E.I.S., New York.

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Iron Mines and Mining: Newfoundland —Wabana Iron Ore Mines of the British Empire Steel Corporation, Ltd., S. C. Mifflen. *Iron and Steel of Canada*, Vol. 13, No. 3, March, 1930.

EXTENT and ownership; deposit is of primary sedimentary origin; layout of mines; all mines are worked through two slopes, each 12 ft. wide on full pitch of metals; method of mining is room and pillar.—E.I.S., New York.

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Iron Mines and Mining: Austria—Iron Industry in Vellach Valley, Carinthia, Austria. L. Jahne. *Montanistische Rundschau*, Vol. 22, No. 1, Jan. 1, 1930.

HISTORY of development of iron mining industry in this district.—E.I.S., New York.

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Electric Furnaces: Metallurgical—Electrochemical and Electrometallurgical Industries of the Pyrenees. *Jl. du Four Electrique*, Vol. 39, Nos. 1 and 2, Jan. and Feb., 1930.

BRIEF report on this new and rapidly growing electrochemical center. Different types of electric furnaces and electrometallurgical processes are described.—E.I.S., New York.

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Zinc Ore Treatment: Electrolytic — Status of Electrolytic Metallurgy of Zinc According to Latest Literature. A. Sanson. *Revue de Métallurgie*, Vol. 27, No. 3, March, 1930.

DETAILS of Tainton process and plant in Kellogg, Idaho; results of tests; roasting, filtration, and purification; advantages of Tainton process.—E.I.S., New York.

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Cement Plants: Grinding Mills—Fineness Tests in a Tube Mill Without Air Separator, Grosse. Forderreuther and Rammler. *Zement*, Vol. 19, No. 9, Feb. 27, 1930. See also translation in *Concrete*, Vol. 36, No. 4, April, 1930.

REPORT of two German committees on cement and on coal; pulverized fuel with admixture of lean fine coal used; description of mill; testing procedure. (To be continued in both issues.)—E.I.S., New York.

Lead-Zinc Mines and Mining: Nova Scotia—The Stirling Mine. J. Nolan. *Canadian Min. Jl.*, Vol. 51, No. 18, May 2, 1930.

DESCRIPTION of mine on Cape Breton Island. Drilled by American Zinc, and by New Jersey Zinc; property is now in hands of British Metal Company, which completed 250-ton oil-flotation mill. Brief note on silver-lead prospect 18 miles to north.—E.I.S., New York.

•

Gold Mines and Mining, Placer: Sampling—A Case of Discrepancy Between Bore Values and Recoveries. J. C. Coldham. *Australasian Institute of Min. and Met.—Proc.*, No. 76, Dec. 31, 1929.

COMPARISON of results of test boring done under contract and of yield from actual mining operations by sluicing and hydraulic elevators; narrow valley deposit of fluvioglacial origin; wash is 80 to 90 ft. deep and is formed in two distinct layers; returns indicate that drill fails to pick up coarse gold, while mined gold shows high percentage of coarse gold in form of thick plates.—E.I.S., New York.

•

Bauxite: Treatment—The Purification of Bauxite. B. W. Grandrud and F. D. de Vaney. *Engineering*, Vol. 129, No. 3355, May 2, 1930.

PAPER indexed in Engineering Index 1929, p. 238, from U. S. Bureau of Mines—Bull. No. 312—E.I.S., New York.

•

Metallurgical Laboratories: Design — Projecting Laboratories for Metallurgical Plants. L. S. Dlugach. *Vestnik Metallopromishlennosti*, No. 11, Nov., 1929.

OUTLINE of general principles of their design, organization, and operation, based on recent experience in establishment of metallurgical laboratories for large plants in Russia.—E.I.S., New York.

•

Mines and Mining: Electric Equipment, Protection—Protection of Motors and Contacts in Deep Mines. E. Nattkemper. *Bergbau*, Vol. 43, No. 3, Jan. 16, 1930.

RULES and apparatus for protection of motors against overheating are discussed.—E.I.S., New York.

•

Electric Furnaces: Melting — Modern Electric Melting Furnaces. H. Illies. *Zeit. fuer die Gesamte Giessereipraxis*, Vol. 51, No. 13, March 30, 1930.

ADVANTAGES of melting in electric furnaces; description of Russ reverberatory arc furnace; Swindell melting furnace; Russ induction furnace for all melting purposes; economic aspects.—E.I.S., New York.

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Lead-Zinc Ore Treatment (Bradford Process) — The Bradford Sulphur Dioxide Process. A. Lowry. *Australasian Inst. of Min. and Met.—Proc.*

DESCRIPTION of application, by North Broken Hill, Ltd., to weathered dump slime; process described in *Mining and Scientific Press*, Sept. 28, 1918, has been simplified in its application; acidity of cir-

cuit, temperature, and sodium hyposulphite have been dispensed with, and now sulphide dioxide is practically all obtained by burning crude sulphur; control and absorption of sulphur dioxide and other details are fully explained.—E.I.S., New York.

•

Lead-Zinc Ore Treatment: Tasmania—The Design of the Rosebery (Tasmania) Concentration Mill — Factors Influencing Choice of Equipment. H. Hey. *Australasian Inst. of Min. and Met.—Proc.*, No. 76, Dec. 31, 1929.

NOTES on specially designed plant to treat ore from Rosebery and Hercules mines; composite feed will assay, zinc 24 per cent; lead, 6.5 per cent; iron, 17 per cent; silver, 7 oz., and gold 2 dwt. per ton; capacity 18 tons of ore per hour; plant layout and flow sheet; details of construction and proposed operation.—E.I.S., New York.

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Mine Shafts: Heating—Shaft Heating, E. Stach. *Bergbau*, Vol. 43, No. 1-2, Jan. 9, 1930.

CLAIM that best air heater at present is steam-heated elliptic ribbed tube, as produced by GEA-Lufthuehler Gesellschaft; advantages of elliptic over round ribbed tubes; arrangement of heating system is described, which can be used in winter for heating and in summer for cooling purposes.—E.I.S., New York.

•

Ore Treatment: Electrolytic — Significance and Status of Electrolytic Processes in Modern Metallurgy, G. Eger. *Zeit. des Oberschlesischen Berg- u. Huettenmaennischen Vereins zu Katowice*, Vol. 69, No. 1, Jan. 1930.

NATURE and purpose of electrolytic processes in extraction of metals are discussed; importance of equivalent numbers as basis of plant design; processes with soluble and insoluble anodes; modern refining processes are described.—E.I.S., New York.

•

Dredges: Design—The Pipe-Line Hydraulic Dredge. O. P. Erickson. *Eng. News-Rec.*, Vol. 104, No. 14, April 3, 1930.

REVIEW of evolution of hydraulic dredge design and construction since 1855; use of Diesel and Diesel-electric power; steam turbines supplant reciprocating engines; suction-pipe, ladder and cutter design; dredge-pump design; pipe-line accessories; steel spuds supplant wood; discharge pipeline practice; gyro-compass guides operation; dredge performance.—E.I.S., New York.

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Ore Sampling—Sampling for Determination of Average Metal Content of Crude Ores and Success of Treatment. E. Barnitzke. *Metall und Erz*, Vol. 27, Nos. 3 and 7, 1st Feb. issue and 1st April issue.

SUGGESTIONS for taking samples; theory of sampling of well-mixed and of unmixed material; comparison of usual sampling methods; factors influencing reliability of sample; practical conclusions.—E.I.S., New York.

•

Ferromanganese Smelting — Experimental Smelting of Ferromanganese in Electric Furnaces. K. P. Grigorovich and V. S. Yemelyanov. *Vestnik Metallopromishlennosti*, No. 12, Dec., 1929.

REPORT on large-scale experiments made by Moscow division of Russian Institute of Metals, using calcium-carbide electric furnace of plant Krassny Autogen; detailed record of chemical changes; expenditure of current and coke.—E.I.S., New York.

Furnaces, Metallurgical: Natural Gas—Industrial Business in the Heavy Metallurgical Field. K. Emmerling. *Gas Age-Rec.*, Vol. 65, No. 11, March 15, 1930.

COMMON engineering metals all require large quantities of fuel of some kind in their preparation for ultimate consumer; in many cases fuel is not only source of heat but is also chemical reagent; natural gas used in finishing processes; walking-beam type conveyor furnaces should increase gas load in sheet mills; natural gas requirements of aluminum industry.—E.I.S., New York.

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Copper Mines and Mining: Cyprus—Copper Mining in Cyprus. T. A. Rickard. *Instn. Min. and Met.—Bul.*, No. 306, March, 1930. See also abstract in *Can. Min. Jl.*, Vol. 51, No. 18, May 2, 1930.

COPPER deposits on island of Cyprus, in Mediterranean Sea, were mined successively by men of Tyre, by Egyptians, by Assyrians, by Phoenicians, and by Romans; orebodies are mainly in andesitic lava, at or near contact with calcareous sedimentaries; ancient and modern mining and metallurgical methods are described. Bibliography.—E.I.S., New York.

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Mines and Mining: Cableways—Tilmanstone Aerial Ropeway. *Colliery Guardian*. Vol. 140, No. 3609, Feb. 28, 1930. See also similar article in *Iron and Coal Trades Rev.*, Vol. 120, Nos. 32-35, Feb. 28, 1930.

DESCRIPTION of ropeway in Kent County, England, to connect Tilmanstone coal mine with Dover harbor; total distance 7.25 miles; 177 trestles, average 30 ft. high; 15 roads and 2 railroads are crossed; net load in buckets is 14.25 cwt.; angle station and tunnel; working costs, with total 6.3 d. per ton, or 0.9 d. per ton-mile; railroad freight was 5s. 9d. per ton.—E.I.S., New York.

•

Furnaces, Metallurgical: Fuel Economy—Heat Economy in Metallurgical Furnaces. R. Hadfield and R. J. Sarjant. *Fuel*, Vol. 9, No. 5, May, 1930.

LOADING of metallurgical furnaces is discussed in relation to convenient modes of studying its influence for purposes of control of heat economy and its bearing on best forms for new construction; instances from works practice are indicated which demonstrate quantitatively advantages of means of control; application of heat-resisting steel to recuperator practice; study of heat exchange in regenerators. Presented before World Power Conference, Tokyo.—E.I.S., New York.

•

Mine Hoists: South Africa—Winding at Great Depths. W. Elsdon-Dew. *Colliery Guardian*, Vol. 140, Nos. 3614 and 3615, April 4 and 11, 1930.

GENERAL notes on steam and electric hoists; several installations at typical shafts on South African mines are briefly described; data refer principally to electric hoists; skips, cages, and trucks; loading arrangement; shaft guides; drum types.—E.I.S., New York.

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Dredges: Electric—Dredge Embodies Unique Portability Developments in Design and Construction. B. S. Carr. *Rock Products*, Vol. 33, No. 9, April 26, 1930.

COLUMBUS GRAVEL COMPANY, Columbus, Miss., placed in use a new 10-in., pump-size electric dredge which is an unusual departure from commonly accepted construction; design affords portability of all elements of dredge where new deposit location set-up is required; boat is of pontoon construction with flat deck, rectangular in shape; Amsco Type H heavy-duty dredge pump is direct-connected to 250-hp. General Electric motor, slip-ring design.—E.I.S., New York.

•

Foundations: Geophysical Testing — Electrical Methods for Sub-Soil Investigation. S. F. Kelly. *Brooklyn Engineers' Club—Proc.*, Vol. 28, Part III, April, 1930.

DISCUSSION of use of direct electric current passed through ground for purpose of studying resistivities of underlying geological formations; cases cited where Schlumberger methods have been applied; discovery of copper orebody of Tilva Roch.—E.I.S., New York.

•

Geophysical Exploration—The Application of Geophysics to Mining. H. Shaw. *Colliery Guardian*, Vol. 140, No. 3616, April 17, 1930. See also brief abstract in *Iron and Coal Trades Rev.*, Vol. 120, No. 3242, April 18, 1930.

REVIEW of magnetic, electrical, gravitational, and seismic methods, with special reference to location of faults. Abstract of paper read before Manchester Geol. and Min. Soc.—E.I.S., New York.

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Mines and Mining: Conveyors—Modern Conveyors. V. D. I. Belani. *Montanistische Rundschau*, Vol. 22, No. 4, Feb. 16, 1930.

WITH AID OF illustrations, improvements in materials-handling equipment in deep and surface mines are described.—E.I.S., New York.

•

Ore Treatment: Germany—Study of Ore Treatment and Coal Preparation in Germany. I. Lazarescu. *Annales des Mines de Roumanie*, Vol. 13, Nos. 2 and 3, Feb. and March, 1930.

TREATMENT of lead and zinc in Germany. Waelz process employed at Fried. Krupp Grusonwerke; flotation process employed at Neuhof mine.—E.I.S., New York.

•

Mine Timbering—Improved Method of Timber Support in Mines. J. Wheatley. *Iron and Coal Trades Rev.*, Vol. 120, No. 3242, April 18, 1930.

BRIEF description of improved method of supporting roof timbers in mines; device consists of malleable iron plate to be fixed between prop and cross-bar; object is to avoid disadvantages arising from use of wooden prop lids, and to minimize risk involved in withdrawing props.—E.I.S., New York.

•

Mine Ventilation—Problem of Special Mine Ventilation. Keyser. *Internationale Bergwirtschaft und Bergtechnik*, Vol. 23, No. 7, April 15, 1930.

ECONOMICAL design of installation based on practical operating conditions are shown; selection of right size of air ducts; volume of air needed and power consumption; influence on temperature.—E.I.S., New York.

•

Metal Mines and Mining: Roumania—Exploitation of Metal Mines in Roumania in 1929. I. Lazarescu. *Annales des Mines de Roumanie*, Vol. 13, No. 4, April, 1930.

REPORTS on gold, silver, lead, zinc, copper, and pyrite mines; production statistics and mining methods.—E.I.S., New York.

PATENTS

Mine Car. No. 1,759,791. May 20, 1930. C. F. Keck, Pleasant Unity, Pa.

Design for a safety block for mine cars.

Classifier. No. 1,759,959. May 27, 1930. A. H. Stebbins, Los Angeles, Calif.

Design for an air classifier.

Concentrator Table. No. 1,759,960. May 27, 1930. A. H. Stebbins, Los Angeles, Calif.

Design for a concentrator table.

Rock Drill. No. 1,760,310. May 27, 1930. E. E. Miller, assignor to Sullivan Machinery Company, Chicago, Ill.

A device for freeing stuck drill steels.

Bit Punch. No. 1,758,492. May 13, 1930. L. C. Bayles, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a bit punch.

Filter. No. 1,758,910. May 13, 1930. L. B. Goodwin, Denver, Colo.

Design for a rotating filter having the form of a truncated cone.

Mine Hoist. No. 1,761,708. June 3, 1930. T. R. Cook and D. N. Smith, assignors to Hudson Coal Company, Scranton, Pa.

An alarm switch for mine hoists.

Rock Drill. No. 1,761,134. June 3, 1930. E. B. Lear, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for valve for rock drills.

Drilling Mechanism. No. 1,761,310. June 3, 1930. C. F. Osgood, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for motor for drill.

Mica-Sorting Machine. No. 1,761,113. June 3, 1930. L. T. Frederick, assignor to Chicago Mica Company, Valparaiso, Ind.

Design for an air separator of mica flakes.

Flotation Apparatus. No. 1,760,916. June 3, 1930. J. P. Ruth, Jr., Denver, Colo.

A flotation device consisting of a number of cells arranged in cascade, the cells having mechanical impellers.

Rock Drill. No. 1,761,313. June 3, 1930. T. R. E. Rundquist, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a fluid-activated rock drill.

Roasting Furnace. No. 1,760,694. May 27, 1930. H. J. Hartley, assignor to Nichols Copper, New York, N. Y.

Arrangement for cooling arms on a mechanical roasting furnace.

Casting Machine. No. 1,756,603. April 29, 1930. A. W. Morris and S. P. Wetherill, Jr., assignors to Wetherill-Morris Engineering, Philadelphia, Pa.

Design for a casting remover.

Granulating Flue Dust. No. 1,755,985. April 22, 1930. H. C. Gardiner, Anaconda, Mont.

A process for granulating dust made by reduction of arsenic-bearing ores, mixing the dust with sulphuric acid and water, and agitating and at the same time drying the mixture.

Copper Metallurgy. No. 1,756,967. May 6, 1930. H. H. Alexander, Westfield, N. J.

Refining of copper under a protective coating of soda glass by introducing pulverized reducing matter under pressure into the molten copper.

Drilling Mechanism. No. 1,760,316. May 27, 1930. C. F. Osgood, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a fluid activated drilling mechanism.

Treating Arsenic, Antimony, and Tin. No. 1,756,007. April 22, 1930. M. F. Perkins, C. W. Hanson, and B. M. O'Harra, assignors to the American Smelting & Refining Company, New York, N. Y.

A process for treating mixtures of alkali oxysalts, including salts of arsenic, antimony, and tin.

Copper Metallurgy. No. 1,757,047. May 6, 1930. M. Hosenfeld & Gunther Hansel, assignors to Siemens Halske A/G. Siemensstadt, Germany.

Process for electrolytic refining of copper and copper alloys, using an electrolyte of cuprous chloride.

Blasting Cartridge. No. 1,757,382. May 6, 1930. E. Ormsby, assignor to Central Mine Equipment Company, St. Louis, Mo.

Design for a blasting cartridge.

Electric Precipitator. No. 1,760,461. May 27, 1930. C. S. Weyandt, assignor to Syntron Company, of Delaware.

An electric precipitator with means for periodically vibrating the conductor consisting of an electromagnetic reciprocating device with electronic control.

Miner's Lamp. No. 1,757,887-89. May 6, 1930. G. Wheat, assignor to Koehler Manufacturing Company, Marlboro, Mass.

Design for electric miner's lamp.

Rock-drilling Mechanism. No. 1,760,354. May 27, 1930. E. G. Gartin, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a rock-drilling mechanism.

Casting Machine. No. 1,756,654. April 29, 1930. H. C. Merrill, assignor to Eagle-Picher Lead, Cincinnati, Ohio.

Design for a machine for casting metallic bars.

Classifier. No. 1,756,960. May 6, 1930. A. H. Stebbins, Los Angeles, Calif.

Design for an air classifier.

Flotation. No. 1,752,434. April 1, 1930. A. L. Howard Hollis, Alaska.

Design for a flotation cell.

Drill. No. 1,753,007. April 1, 1930. C. C. Hansen, assignor to Ingersoll-Rand Company, Jersey City, N. J.

Design for a drill-feeding device.

Rock Drills. No. 1,755,255. April 22, 1930. R. Griffith, assignor to The Gardner-Denver Company, Quincy, Ill.

Design for a rock-drill guide.

Drilling Mechanism. No. 1,761,337. June 3, 1930. E. T. Hall, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for drilling mechanism.

Aluminum Metallurgy. No. 1,761,442. June 3, 1930. P. E. Froland, Hoyanger, Norway.

Design for an electric furnace for production of aluminum.

Phosphate Rock. No. 1,761,546. June 3, 1930. W. Trotter and E. W. Wilkinson, assignors to Minerals Separation Company, New York, N. Y.

A process for concentrating phosphate-bearing material by flotation.

Drilling Mechanism. No. 1,761,357. June 3, 1930. E. E. Miller, assignor to Sullivan Machinery Company, Chicago, Ill.

Design for a drilling mechanism.

Zinc Metallurgy. No. 1,761,782. June 3, 1930. O. A. Fischer, assignor to R. H. Channing, Jr., San Francisco, Calif.

Process of oxidizing soluble iron salts in a zinc sulphate solution by a mixture of sulphur dioxide and an oxidizing gas.

Recovery of Volatile Metals. No. 1,759,559. May 20, 1930. W. Job, assignor to American Lurgi Corporation, New York, N. Y.

Blast furnace for recovery of volatile metals in form of oxides.

Lead Metallurgy. No. 1,759,494. May 20, 1930. U. C. Tainton, East St. Louis, Ill.

Method for recovering lead from carbonates and sulphates by leaching with alkali hydroxides, electrolyzing the resulting solution.

Blast Furnace Tuyere. No. 1,759,114. May 20, 1930. E. H. Holzworth, Buffalo, N. Y.

Design for a water-cooled blast furnace tuyère.

Reduction of Oxides. No. 1,759,173. May 20, 1930. W. H. Smith, Detroit, Mich.

Furnace for reduction of metallic oxides without melting.

Nickel Metallurgy. No. 1,756,092. April 29, 1930. F. Lathe, Ottawa, Canada.

A method for refining nickel-copper matte, which consists of a rapid cooling of the liquid matte to increase the solubility of the nickel sulphide in dilute acid.

Manufacture of Lithopone. No. 1,759,115-6. W. C. Hooey, assignor to New Jersey Zinc Company, New York, N. Y.

Improvement in the manufacture of lithopone by establishing a predetermined excess of and ratio between the hydrate and sulhydrate radicals in the crude pulp at the end point of the precipitating step.

Comment and Criticism

New Uses for Silver

To the Editor of "E.&M.J.":

The decline in the price of silver has brought about a discussion of ways and means to increase demand, and it is generally agreed that research and development work would help to create new outlets. Research has been carried out on non-tarnishing silver alloys, which are comparatively expensive and so cannot compete with such alloys as Monel metal and stainless steel if cost is an important item. The best way to create new demands for silver in the industry will be the development of silver alloys—such as the silver solders—that cannot be replaced by other alloys.

Silver used as contact material in electrical apparatus cannot be replaced by cheaper metals. The superiority of silver for such purposes is due not only to its high electrical conductivity but also to the conductivity of silver oxide and silver sulphide, both of which are formed under normal atmospheric conditions. Copper, ordinarily used, is inferior to silver because both copper oxide and copper sulphide are electrical insulators. Copper is used in most cases because of its lower cost, silver being employed only where copper will cause trouble in service.

The strength and hardness of silver-copper alloys that are rich in silver can be considerably increased by suitable heat-treatment. Research work on this subject has been carried out by English and German scientists in the last three years, but no such work has to my knowledge been done on copper-silver alloys that are rich in copper, probably because they are not expected to have practical application. Precipitation hardening probably takes place in copper-silver alloys that are rich in copper, and I believe that these alloys will be suitable for electrical material such as trolley wire and trolley wheels. The increase in cost because of the presence of silver may be more than offset by longer service.

Hard-drawn copper wire having an electric conductivity of 100 per cent and an ultimate tensile strength of 60,000 lb. per square inch, previously exclusively used for trolley wire, is being replaced by hard-drawn alloy wire containing about 99 per cent copper and 1 per cent cadmium and having an electric conductivity of 90 per cent and an ultimate tensile strength of 100,000 lb. per square inch. This alloy wire is more resistant to wear than is electrolytic copper wire, and the length of spans can therefore be increased. These advantages more than offset the disadvantage of lower electric conductivity.

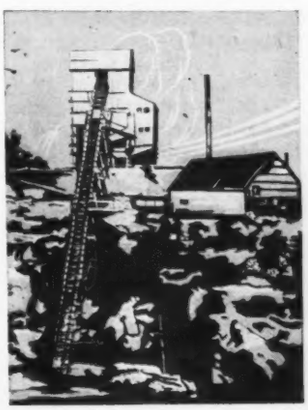
The silver-copper alloys that are rich in silver have been found to respond to heat-treatment in the same manner as Duralumin. It is thus possible to obtain a considerable increase in ultimate tensile strength and hardness, together with an increase in electric conductivity. If investigation should prove the susceptibility of the copper-silver alloys that are rich in copper to similar treatment, one might expect, as a result, the development of a new silver alloy for trolley wire, superior to the present alloy with regard to strength as well as to electric conductivity and arcking properties.

The mileage of a trolley wheel depends on several factors, among which are wear resistance and the arcking properties of the alloy used; grain structure, and freedom of the casting from blowholes or oxide inclusions; and conditions on the line. Trolley wheels made of copper only are not in general use, because of the difficulty in getting sound copper castings. Most trolley-wheel alloys contain tin and zinc, in addition to copper.

Several years ago, while conducting an investigation on trolley wheels, I ran across some data on an alloy containing 99.5 per cent copper and 0.5 per cent silver. Service results of wheels of this alloy compared favorably with those made with the commonly used alloys. An investigation on the use of bronzes containing silver, as trolley-wheel alloys, would give valuable and interesting results.

JAMES BRINN.

Chicago, Ill.



Metallurgical Nomenclature in the Tri-State District

To the Editor of "E.&M.J.":

You will see by the inclosed list of definitions that an attempt is being made to bring the usage of metallurgical terms in the Tri-State district into conformity with the practices elsewhere. It is hoped especially to encourage the use of the term "concentrate" instead of "ore"; that is, for the meaning for which the latter term has long been used here. If publications will adopt these usages invariably, the habit can be quickly established.

It is recognized that this letterhead of the Tri-State Zinc & Lead Ore Producers' Association does not as yet conform to the approved practice.

M. D. HARBAUGH, *Secretary,*
Tri-State Zinc & Lead Ore Producers' Association.

Miami, Okla.

The list of definitions forwarded by Mr. Harbaugh follows:

DEFINITIONS OF METALLURGICAL TERMS ADOPTED BY THE TRI-STATE METALLURGICAL ASSOCIATION

Ore—Mineralized rock or earth material which is, or may be, mined for metallurgical treatment. Ore is locally termed "rock" or "dirt."

Concentrate — The product recovered from any ore-concentrating operation. Concentrate is locally termed "ore."

Heads—Feed material for any ore-concentrating operation.

Tailings or tails — The product discarded from any ore-concentrating operation.

Middling — An intermediate product from any ore-concentrating operation which is subject to further treatment.

Smittem—A local term describing the hutch product of a roughing jig.

Chat—A term used locally to describe fragments or particles of ore containing interlocked minerals with or without gangue.

Recovery—A local term for the percentage, by weight, of concentrate produced from ore.

Ratio of Concentration—Ratio of weight of ore to weight of concentrate produced. It is the reciprocal of recovery as understood locally.

Extraction—That percentage by weight of any given metal or mineral in the heads which is recovered in any metallurgical operation.

Percentage Distribution—The percentages by weight of the total quantity of any given metal or mineral in the heads that are contained in the several products of any metallurgical operation.

New Publications

GEOCHEMISCHE MIGRATION DER ELEMENTE. *By A. Fersmann. Part II. Abhandlungen zur praktischen Geologie und Bergwirtschaftslehre, Band 19. Pp. 86. Halle, Germany: Wilhelm Knapp.*

THE first volume of this work was reviewed in a previous issue. In the present volume, the author describes the uranium-vanadium-radium deposits of Tuja-Mujun, in Turkestan, and the sulphur deposits in the Karakumy desert, southeast of the Caspian Sea.

In the northern foothills of the Alai Mountains, a broad belt of steeply folded Paleozoic sediments with conformable flows of diabase and keratophyre strikes east-west. Vertical beds of Mississippian limestones form a rugged mountain range through which the Aravan River has cut a canyon, 800 ft. deep. The ore deposits occur in vertical chimneys, stopes, and irregular caverns in the limestone ridge, well above the present ground-water level. The ore minerals are the hydrous copper vanadates turanite and tangeite, colloidal tujamunite, a hydrous calcium uranium vanadate, and radium-bearing barite with 1.16×10^{-6} gram of radium per gram of barite. A cross-section through an ore chimney shows a telescopic structure, with the following concentric zones distinguishable from the walls to the central cavity: (1) Fibrous calcite; (2) "ore marble," composed of calcite with irregular fragments of tujamunite; (3) red barite; (4) yellow barite; (5) cavity with a mixture of barite, gypsum, and calcite. The average diameter of the orebody is 9 ft.

The caves resulted from descending waters, which dissolved the limestone. Two horizons of particularly large caverns correspond in elevation with two river terraces, suggesting two periods of stable ground water in the erosional history of the region. The ores described were introduced in post-Eocene time through tepid ascending sulphate solutions, and colloidal uranium vanadates with copper were deposited along the walls of the caverns. The thermal activity ends with the deposition of barite; thereafter, the descending waters regain control of the caves, and calcite is again being formed. A part of the vanadium has possibly been leached out from the limestone and was not introduced entirely through the thermal springs; even now vanadium compounds are being precipitated in the mines. The mineralization of Tuja-Mujun resembles that of the carnotite deposits of the Colorado Plateau.

About 300 miles east-southeast of the Caspian Sea, a group of erosion remnants overlook the general level of an extraordinarily hot desert, in which summer temperatures up to 175 deg. F. (80 deg. C.) have been recorded. The brilliantly colored hills rise some 270 ft. above the plains and are composed of horizontal sandstones of Pliocene or Pleistocene age (post-Sarmatian). The hills are capped by thick crusts of opal of recent origin, and in the uppermost 60 ft. of sediments elemental sulphur is found, either as a cement in the sandstone, together with opal; as sulphur lenses in poorly cemented layers; as cement between flint concretions; or as sulphur veinlets crosscutting the white sandstone. The following origin of the sulphur beds is suggested:

On the bottom of playa lakes which were exposed to humid and arid seasons concretions of opal and flint have formed. Sulphates, present in the same playas, were reduced to native sulphur, probably through biochemical agencies. The playa stage is discontinued and followed by a period of uplift and erosion which leads to the present stage, which has converted the former playa beds into erosion remnants.

At present, the easily soluble sulphates, carbonates, and chlorides (especially gypsum, sodium carbonate, and rock salt) effloresce on the desert surface. The crusts which they form are constantly brecciated because of unequal expansion in the scorching summer heat. A part of the colloidal silica also moves toward the surface, giving rise to opal crusts and local silicification in certain layers. The sulphur stays behind and recrystallizes, but a part of it oxidizes into SO_2, SO_3, and even into sulphuric acid, through the co-operation of silica gel. The process of silica migration is taken up in considerable detail in the volume here under review, and our knowledge of similar processes in the African and Australian deserts is examined. Those who want to read a lucid analysis of the migration of the elements in deserts will enjoy this part of the book in particular.

ROBERT BALK.

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ASPHALT AND ALLIED SUBSTANCES. *By Herbert Abraham. Third edition. New York: D. Van Nostrand Company. Pp. 890; illustrated. Price $10.*

Since 1918, when the first edition appeared, the rapid development of the asphalt industry has necessitated frequent revision. The present volume will prove valuable to all interested in the composition, merchandising, and application of bituminous products. It contains chapters on history, classification and chemistry, origin and geology, and mining and refining, and descriptions of the principal deposits of the world. Ample space is devoted to the distillation processes producing residual bitumen and the industrial applications of the various products. Methods of sampling and testing raw materials and finished products are included. A bibliography and a complete set of references complete the volume.

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BEARING METALS AND BEARINGS. *By W. M. Corse. New York: Chemical Catalog Company. Pp. 374. Price $7.*

This book is one of a series of scientific and technologic monographs being issued by the American Chemical Society. The author reviews the history of bearings and bearing metals, the development of various types of bearings, with discussion of designs to be used for specific purposes and the causes for trouble and failures. Methods for testing and a discourse on lubrication are included.

The main part of the book, over 200 pages, is devoted to abstracts from periodicals from all parts of the world, to give the reader a comprehensive picture of the present status of the industry, without claim on the part of the author as to the validity of any theory or practise set forth in these abstracts. A complete bibliography adds to the value of the book.

B. H. STROM.

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NEW BRUNSWICK, CANADA. ITS NATURAL RESOURCES AND DEVELOPMENT. *By L. O. Thomas. Obtainable from the Director, Natural Resources Intelligence Service, Department of the Interior, Ottawa, Canada. Pp. 167.*

Of particular interest to readers in the mining industry will be the 31-page section relating to minerals. This includes a brief sketch, with map, of the geologic formation of the province, and a second map, with table, showing the mineral occurrences and their stage of development, concerning which details are given in the text.

■

ABRASIVES. *A Publication of the Late Imperial Mineral Resources Bureau and the Imperial Institute. London: H. M. Stationery Office. Price 2s. 6d.*

This pamphlet is one of a series of reports on the mineral industry of the British Empire and foreign countries. Abrasives discussed are: Diamonds, corundum, emery, garnet, silica abrasives, pumice and volcanic dust, and artificial abrasives. Detailed information relative to world production, uses, occurrence, and distribution of the principal abrasives is presented. A number of the less important artificial abrasives are referred to briefly. International trade statistics, ending with the year 1928, are included in the sections of the paper devoted to the principal abrasives.

INDUSTRIAL PROGRESS

Three-way-dump Car and Locomotive Facilitates Building of Stockpiles and Dumps

Other New Equipment

A NOVEL combination of car and locomotive which hauls six trailer cars was described in the Feb. 8, 1930, issue of *Engineering and Mining Journal,* on page 151. This was developed by the Differential Steel Car Company, Findlay, Ohio, and resulted from motorizing one of the cars, thereby replacing the usual electric locomotive. Weight

Building a dump with new three-way-dump train

and rolling friction of the train were less than for a standard locomotive and seven cars. With the train loaded or unloaded, the locomotive car weighs enough to exert the proper tractive pull. The body, both of the motorized car and of the trailer, was of the side-pivoting type, with down-folding doors, and could be dumped to either side by a central air cylinder. Another interesting development along somewhat similar lines has just been announced by the company. This is the so-called Differential train, intended for waste disposal and stockpiling. It represents a distinct advance in design for equipment of this sort. The train consists of an electric-driven unit—that is to say, a motorized car having a dump body mounted on its chassis, and a trailing car (one or more) which is also a dump car. Each car is of 10 cu.yd. capacity, level full. Dumping is automatic, compressed air furnishing the power. The locomotive car dumps to each side. In addition to dumping to each side, the trailer dumps also over the end, in this way being a three-way-dump car. The train is said to have a greater useful capacity than any similar equipment with the same over-all dimensions; also greater capacity per unit of weight.

A dump as it grows must often be extended in three dimensions—that is, lengthwise along the track, and also to either side to widen it. At times it may also be desirable to gain elevation. The train described can accomplish all these purposes with minimum labor. Loaded, it proceeds to the end of the dump and, if the latter is to be extended laterally, both locomotive car and trailer may be dumped to either side. If the dump is being extended along the line of the track, the trailer, pushed ahead of the locomotive, may be dumped over the end, which can be continued until there is a pile of material sufficient to elevate the track when the latter is extended on to the new part of the dump. This train is shown in one of the accompanying cuts.

The same company has also introduced a combination locomotive and car having an internal-combustion power plant on one end of the chassis, together with complete control and drive equipment mounted on an underframe capable of carrying an automatic dump body. The tractive effort required is automatically regulated, as described in the Feb. 8 issue. In this locomotive, the dump body has a level load capacity of 24 cu.yd. with a normal crown load capacity of nearly 40 cu.yd. It may also be equipped with the following combination of power-generating plants and drives: gasoline-motor mechanical drive; gasoline-motor electric drive; Diesel motor-mechanical drive; and Diesel motor-electric drive.

Machine Builder Has Available a New Material

A new cellulose product, known as maizolith, has been used on a small scale in the manufacture of noiseless gears, rods, tubes, refillable fuses, rings, disks, wheels, bearings, screws, and nuts, according to a publication of the U. S. Bureau of Standards. This is a dense, hard, bonelike substance made by cooking cornstalks or corncobs with caustic soda, washing the residue, beating it to a jell, and drying. The finished product has a modulus of rupture of about 16,000 lb. per square inch and a volume resistivity of 3×10^9 ohms per cu.cm. It is practically unaffected by oil, but becomes soft on prolonged soaking in water.

Cost figures for the process indicate that in a plant large enough to produce 5 tons per day of finished maizolith can be made for about $240 per ton, using cornstalks as the base material. The substance could probably be made at a lower figure than $240 per ton as a byproduct of the insulating wall-board industry, by utilizing fibers or pith particles which are too fine or too highly hydrated to be used in insulating board.

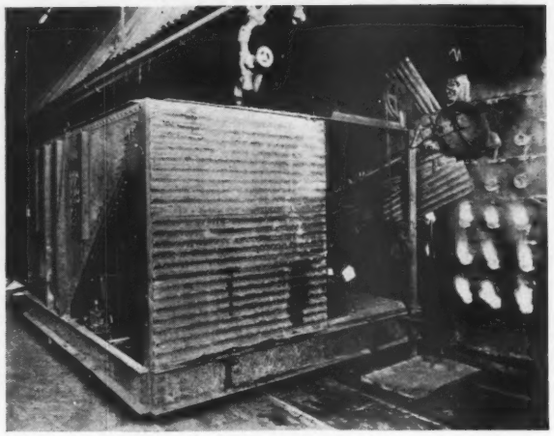
By utilizing the soft residue from the process of extracting adhesive material from corncobs, maizolith could probably be produced at a lower figure than is possible with either of the processes outlined in the foregoing.

A Speed Governor

A governor that may be used to guard against the overspeed or underspeed of machinery in mills or in any other place where speed control is desirable has been developed by the Duro Metal Products Company, 2649 North Kildare Ave., Chicago (makers of the Lilly hoist controller). Through electrical means, warnings may be given by it and controls operated at remote points. As shown in a cut, it is inclosed and may be used in dirty places or even outdoors. Inside its housing is a fly-ball governor with a mechanism for operating electrical contacts. These are in the upper part of the casing where they are accessible, and the governor mechanism is in a lower compartment. The contacts may be arranged in many ways. The governor is equipped with Timken bearings and ball bearings, and is automatically lubricated by a positively driven oil pump within the casing.

A negligible amount of power is required to run the device, inasmuch as

New speed governor of fly-ball type is fully inclosed and may be used in dusty places or outdoors



This machine charges zinc retorts more rapidly than the hand method and with a resultant saving in fuel

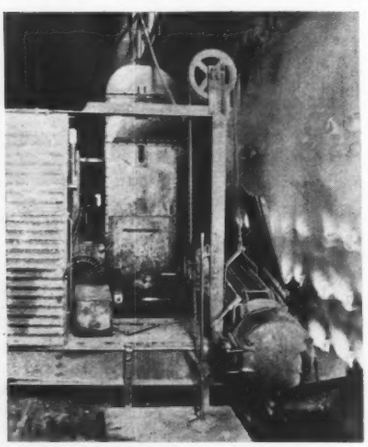
the shaft may be turned by finger and thumb. With its housing, the governor is very compact, being 11$\frac{13}{16}$ in. high, 7 in. wide, and 11$\frac{1}{4}$ in. long.

Machine Replaces Hand Method of Charging Zinc Retorts

What the manufacturer claims is an entirely new idea in charging zinc retorts of the Belgian-type furnace is embodied in a piece of equipment developed by the Beardsley & Piper Company, of Chicago. The machine is shown in accompanying cuts. In one illustration it is seen charging a retort in the topmost tier, and in the other it is in position to charge one of the lowest retorts. The basic idea is taken from the design of the sandslinger, a ramming machine used in over 600 foundries throughout the world. The unit is driven electrically and will charge from 7 to 10 cu.ft. of material per minute as it travels on tracks along the side of a furnace, ramming to proper density retorts high or low and each with equal facility. The ramming head is adjustable so as to be easily aligned with the retorts and is raised or lowered at will by a hand wheel which operates a chain hoisting and lowering device.

Manual labor is reduced to operation of the machine, the blue powder being conveyed by belt conveyors from a bin or hopper on the machine to the ramming head, where it is discharged horizontally in any predetermined quantity and density into the individual retort. The operator is protected from the intense heat of the furnace by a metal shield and is not required to do any shoveling or other heavy labor.

This method of charging has resulted in a considerable saving in fuel and has increased the charging speed by 15 per cent as compared with the hand method. What formerly constituted a hazardous and highly skilled labor operation has now been reduced to ordinary machine work. The new machine is said to have been tested and is now being operated by several zinc companies.



Another view of the zinc-retort charging machine

Acid-Resistant Material for Construction

A new acid-resistant material for chemical, metallurgical, and allied industries is being marketed by the Prodorite Company, Pratteln, Switzerland. It is known as "Prodorite" and is made by mixing pure sized quartz intimately with a special pitch at high temperature. The mixture is poured into molds while hot and sets in a few hours. It has the strength of reinforced concrete and is as impervious as tile. Two products are made, one to resist high acid concentrations, and another for liquors with less corrosive qualities, such as organic acids and impure water. This material is made up into leaching vats, launders, pipe lines, chimneys, flooring, tank lining, and various other forms. Tanks up to 5 tons' capacity have been cast in one piece. Some of larger size have been made by joining pieces together by a special cement that is made of the same composition as the Prodorite itself.

These Engines Burn Distillate

A line of internal-combustion engines equipped to burn distillate is now being turned out by the Climax Engineering Company, Clinton, Iowa. These engines are sold under the name of "Blue Streak" and are produced in five sizes varying from 70 to 200 hp. The cylinders are of chrome-nickel iron.

Diesels and Steam Utilization

IN certain steam power plants supplying both heat and power, Diesel engines may be used advantageously to increase the efficiency of steam utilization. This subject was discussed by E. J. Kates at the meeting of the A.S.M.E. at State College, Pa., on June 12-14. The speaker developed the following points:

1. Diesel engines can be effectively used in conjunction with certain types of steam power plants to produce power and heat at low over-all cost. Their utility consists in enabling the steam plant to produce the optimum quantity of byproduct power from space-heating and process steam, while the Diesel units generate the remaining power at lower cost than a steam plant would.

2. In such joint steam and Diesel power plants the total plant capacity need not exceed that of a corresponding all-steam power plant. Despite some loss in thermal economy, the decreased investment results in lower over-all costs.

3. In any study of the use of power steam for heating purposes, the exhaust use factor must be determined with the utmost care. Detailed analysis of power and heat requirements at all hours of the day and at all times of the year must be made; otherwise the amount of exhaust steam utilized may be greatly overestimated, and erroneous conclusions reached.

4. The actual design of a joint steam and Diesel power plant is a piece of real engineering, and deserves the application of competent engineering skill and experience.

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Foundation Piling Improved

THE eleven-story building being erected by the Westinghouse company to house its General Engineering Laboratories at East Pittsburgh, Pa., is supported on a new type of concrete piling, which is made by the hollowspun or centrifugal process in exactly the same manner as the hollowspun granite columns used as supports for street lighting units and trolley wires. These piles are approximately 20 ft. long, 9$\frac{1}{2}$ in. in diameter at the small end, and 14$\frac{1}{2}$ in. in diameter at the large end. They were driven to bedrock 20 to 25 ft. below the surface with a large steam hammer. Despite the terrific blows, practically no spawling or brooming at the butt end took place. Ten piles were withdrawn for test purposes. Their condition showed that they had been driven through a stratum of large rocks without apparent damage. Subsequent tests for columnar loads developed an average load-bearing capacity of 150 tons before failure, each failure being of the compression type and not columnar.

To make these piles a reinforcing cage of longitudinal steel bars wrapped spirally with wire hooping is built up

A Modern Dinosaur

This Oldroyd electric coal-loading machine, in use at the Wildwood mine of the Butler Consolidated Coal Company, near Pittsburgh, Pa., will interest mining operators outside of the coal industry. It is 57 ft. long, weighs over 60,000 lb. and loads a 5-ton car in 30 seconds. Two men operate it, one regulating the gatherer and the other the overhanging chute at the left. The gatherer, operating on a swivel, picks up coal within a large radius. It is also able to exert a 60-ton force against the side of the vein to dislodge coal not shot down.

and placed in steel molds. After the mold is filled with a specially prepared concrete mix, it is spun in a horizontal position for about 15 min. at varying rates of speed. The spinning compacts the concrete into a dense mass and forms a central hollow core, whence the name "hollowspun." In street-lighting columns this hollow core is used advantageously for wiring, and in piles it makes it possible to jet these in place with water pressure.

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Pipe Line Welding Facilitated by New Steel Flange

A butt-welding flange of forged steel that makes it easier to join pipe than where threaded connections are used has been introduced by Taylor Forge & Pipe Works, Chicago, Ill. These flanges have been developed for use in connection with welded lines for inserting valves and fittings, and taking off outlets. Their use is said to save time and labor and to more than satisfy the full American Standard strength requirement. The hubs have been designed to make welding of the flanges simple and without risk of warping, if ordinary welding skill is employed. The flange may be had up to 96-in. pipe size.

Welding a forged steel flange in laying a pipe line

Adequate Spare Parts Mean Continuous Performance

ALTHOUGH stocking repair parts for a machine is operation insurance, the thought is one to which some companies are apparently indifferent. Ideas differ as to the value of such insurance. Some individuals are thoroughly "sold" and adequately covered. Others prefer to take a chance. But before one criticises the latter, one should know the facts.

Stocks of spare parts can easily be too large. If the parts are expensive, the loss in interest may be heavy. Moreover, where the practice of maintaining generous stocks prevails, one is likely to find "stickers" on the warehouse shelves—parts that are useless because the machine for which they are intended is no longer used, or parts that will not be used, simply because they wear out so slowly that a few will do for a long period of operation. Added to these may be parts that are defective, a condition attributable to faulty buying and failure to inspect on purchase.

Efficient management naturally will not tolerate such conditions. But efficiency also requires that stocks be adequate and that spare parts be kept on hand in quantity sufficient to insure continuous operation. The quantity carried will depend on the situation of the plant and on the resultant length of time required to secure parts from the manufacturer. Where the source of supply is near, the stock may be of minimum size. For remote locations this condition is reversed.

Continuous operation of prime movers is most important. Evidence of what the stocking of spare parts can accomplish to this end is seen in the Magnolia Petroleum Company's plant at Luling, Tex. At this station, according to E. W. Hammond, of the Worthington corporation's Buffalo Works, seven Worthington 600-hp. engines are installed. Cylinders total 42. All engines run 24 hours daily throughout the year, with 100 per cent load factor and only 1 per cent loss in operating time. In the last four years, no shutdown has taken place. Replacements have been made periodically instead of when forced by breakdowns, this fact accounting for the excellent performance.

In this connection, says Mr. Hammond, one should note that parts periodically replaced can be economically repaired. When damaged so badly as to cause forced shutdowns, however, they cannot be repaired. He concludes, therefore, that low maintenance costs are possible only through carrying sufficient spares to permit periodic inspection and replacement with minimum loss of time.

Bulletins

Rotary Drilling—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Leaflet No. 20444. Electrical equipment for rotary drilling.

Controllers — General Electric Company, Schenectady, N. Y. Announces new self-contained controllers for low-head cranes.

Flotation—Southwestern Engineering Corporation, 606 South Hill St., Los Angeles, Calif. Bulletin No. 230. Factory-built flotation plants.

Welding—Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Datum No. 11. Arc welding of cast iron.

Synchronous Motors—General Electric Company, Schenectady, N. Y. Bulletin No. 1191. Synchronous motors.

Excavators—American Hoist & Derrick Company, St. Paul, Minn. Booklet.

Welding—Linde Air Products Company, 30 East 42d St., New York City. Book, "Oxwelded Construction for Modern Piping Services."

Pumps—Goulds Pumps, Inc., Seneca Falls, N. Y. Bulletin No. 200. Centrifugal pump selection charts, horizontally split inclosed impeller pumps, single-stage double-suction type.

Welding—General Electric Company, Schenectady, N. Y. Bulletin No. GEA-876D, which describes Type WD-400A arc welder.

Personal Notes

Frederick Laist has returned to New York from Europe.

J. Parke Channing recently returned to New York from London.

R. P. Mills has been appointed assistant chief clerk of the New Cornelia mine, at Ajo, Ariz.

T. C. Foster, Arizona State Mine Inspector, has announced his candidacy for re-election this fall.

Ira B. Joralemon, mining engineer, of San Francisco, has returned from a short business trip to New York.

P. C. Schraps, former mill superintendent for the Howey Gold Mines, Ltd., has returned to California.

J. F. Geary, consulting engineer, has opened an office at 707 Rives-Strong Building, Los Angeles, Calif.

W. Val de Camp recently gave a talk on the copper situation before the Kiwanis Club of Jerome, Ariz.

Corey C. Brayton, of Oakland, Calif., sales engineer for the American Manganese Steel Company, was recently in Potosi, Bolivia.

Louis A. Wright is at his home in San Mateo, Calif. He will return to London in the near future, taking his family with him.

James A. Barr, chief engineer of the International Agricultural Corporation, returned to Tennessee early in June after a trip abroad.

John T. Shimmin, metallurgical engineer, has resigned from his position with the Collins Western Corporation, Inc., of Los Angeles.

W. B. Gomez has resigned from the staff of Miami Copper, to accept a position as mining engineer with Bagdad Copper, at Hillside, Ariz.

Alfred B. Sabin, formerly assistant superintendent of the concentrator at El Tigre, Sonora, Mexico, has recently been appointed superintendent.

C. A. Farlow has resigned from the staff of Miami Copper to accept a position with the U.S.S.R. He expects to leave for the Ural Mountains in July.

Arthur W. Furbank has returned to New York after an extended tour through the Southwest, in which he visited several of the large flotation plants.

Edgar Rickard sailed recently from New York for Belgium, where he will assist in the administration of funds for the Commission for the Relief of Belgium.

Richard A. Parker received the honorary degree of doctor of science at the recent commencement exercises of the Colorado School of Mines, at Golden, Colo.

Clarence Woods, of Santo Domingo Gold Mining, at Tirapata, Peru, passed through New York recently, on his way to California, where he will remain until his return to Peru in September.

Donald F. Young, manager of the California plants of the American Manganese Steel Company, has returned to Oakland, Calif., after a business trip to the Federated Malay States.

R. L. Lape, superintendent of the copper electrolyzing department of Anaconda Copper's Great Falls plant, recently spent a week at the company's Raritan unit, Perth Amboy, N. J.

Dr. **George Otis Smith** delivered an address at the commencement exercises of the Montana School of Mines, on June 6, at Butte, Mont. His subject was "The Engineer's Larger Opportunity."

F. L. Miskin, general manager for Henry Gardner & Company, sales agents for Consolidated Mining & Smelting Company of Canada, recently visited the Sullivan mine and the Tadanac smelter.

John T. Reid, mining engineer, of Lovelock, Nev., who underwent several operations at the University of California Hospital during the last few months, has returned to his office at Lovelock.

Arthur D. Storke, who recently returned to London from a visit to the Roan Antelope and Selection Trust copper properties in Northern Rhodesia, sailed on June 18 for New York to join **Chester A. Beatty.**

J. I. Moore, Jr., superintendent of the Britannia mine, at Britannia Beach, B. C., for the last eight years, has been appointed general superintendent of the Holden copper mine, near Chelan, Wash., now under development by the Howe Sound Company, which also owns the Britannia.

T. H. Oxnam, who has been a metallurgical engineer for Nevada Consolidated at Hayden, Ariz., for several years, has accepted a position with the European branch of the Southwestern Engineering Company. His new work will take him into France, Germany, Italy and Belgium.

Walter Jewitt, field engineer for Consolidated Mining & Smelting, has left Trail, B. C., for South Africa. He will meet and confer with W. M. Archibald, vice-president in charge of mines for the company, in England. Mr. Archibald is returning from South Africa, where he attended the Triennial British Empire Mining Congress.

D. C. Jackling, president of Utah Copper; **L. S. Cates,** president of Phelps Dodge; and **W. S. Boyd,** vice-president and managing director of Nevada Consolidated, were in Salt Lake City early in June for a trip of inspection of Western properties. On June 9, at a banquet in Salt Lake City, Mr. Cates was presented with the twenty-year continuous service medal of Utah Copper.

Albert Mendelsohn has been appointed general superintendent of the Champion and Copper Range mines of the Copper Range Company, near Painesdale, Mich. He has been underground superintendent for the last ten years, and prior to that he was superintendent of the Baltic mine. He is a graduate of Columbia University, and his first position with the company was that of engineer of mines.

Carlton D. Hulin, associate professor of geology at the University of California, has just completed a month's field work in the Mojave Desert, where he was making a study of the geology of the Searles Lake Quadrangle for the California State Division of Mines. He is now engaged in consulting work at the Sunnyside mine, in southwestern Colorado, for the United States Smelting, Refining & Mining Company.

Dr. **Zay Jeffries,** consulting metallurgist of Cleveland, Ohio, delivered the address at the forty-third annual commencement of the South Dakota State School of Mines, at Rapid City, S. D., June 5. It was the twentieth anniversary of Dr. Jeffries' graduation from the institution, and in recognition of his achievements in metallurgy and metallography, the School of Mines bestowed upon him the degree of doctor of engineering.

Harry Backus Henderson, of Santa Barbara, Calif., has been awarded the newly established Cornelius F. Kelley fellowship in ore dressing, which has been established at the Montana State School of Mines. The fellowship, amounting to $2,500 annually, is for the study of the fundamentals of flotation concentration and has been established through the co-operation of Anaconda Copper. Mr. Henderson had been engaged in flotation research at the school, under the direction of Prof. A. M. Gaudin, for the last year.

Scott Turner has received notification from the Secretary of State of his designation as a delegate on the part of the United States to the second plenary meeting of the World Power Conference to be held at Berlin in the latter part of June, and he has also received from the same source his appointment as one of the two American delegates on the part of the United States to the International Congress of Mining, Metallurgy, and Applied Geology to be held at Liége, at the end of June. Mr. Turner is also an official delegate of the American Committee of the World Power Conference, and carries credentials of the A.I.M.E. to the same conference.

OBITUARY

Louis H. Timmins, vice-president of Hollinger Consolidated, died at his home in Montreal, Que., on June 1.

Eugene M. Farnham, mining engineer, of Oakland, Calif., died on June 8, in Oakland, at the age of 53. He was a graduate in mining of the University of California, 1902, and was at one time owner of quicksilver properties near Mina, Nev.

Sir Friedrich Epstein, member of the Wernher Beit Company, which later became part of Central Mining & Investment, died in London on June 10. Sir Frederick went to Johannesburg in 1887 and took a leading part in the development of the Witwatersrand.

NEWS OF THE INDUSTRY

Phelps Dodge Signs Contract to Use Natural Gas

Natural gas will be used as fuel by at least one of the large copper-mining companies in Arizona, announcement having been made early in June that Phelps Dodge has signed a contract for use of gas at its plants at Douglas, Bisbee, Clifton, and Morenci. This announcement follows the news, released in the middle of May, that engineering firms were considering construction of a 500-mile pipe line from Texan oil fields to supply Arizona smelters and homes with fuel. The Phelps Dodge contract was signed with the Western Gas Company, of El Paso, Tex. Calumet & Arizona, another large Arizona copper producer, and Arizona Edison are also said to be negotiating contracts. As Calumet & Arizona and Phelps Dodge are considering a merger, the possibility that the former will also use natural gas is good. The official announcement by P. G. Beckett, general manager, follows:

"Phelps Dodge has signed a contract for natural gas. The contract covers its fuel requirement at Douglas, Bisbee, Clifton, and Morenci for a period exceeding ten years. Engineering work on pipe line now is under way, but any announcement as to when the line will be completed into Bisbee and Douglas will have to come from the officers of the Western Gas Company."

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Mining Men Win Dispute Over Denver-Leadville Line

Mining interests of Park and Summit counties, in Colorado, have won a victory in their fight to prevent abandonment of the Colorado & Southern narrow-gage line between Denver and Leadville, Colo. The Interstate Commerce Commission denied the railroad's petition, and at the same time refused to permit the Denver Water Board to relocate several miles of the line, even at its own expense, for the purpose of constructing the Two Forks Reservoir on the South Platte River.

In its original petition, the railroad maintained that the entire South Park division, as it is generally called, had been operated at a loss for years, and offered to give it away to any individual or company who could prove ability to continue to pay operating expenses. The offer was never accepted, because not one of those willing to accept was financially able to make the guarantee. Opponents of abandonment suggested that methods of bookkeeping might account for some of the loss claimed.

In making its decision the Commission seemed particularly impressed with the needs of the mining industry, and found this line indispensable to several of the larger mining developments of that region, especially the Climax Molybdenum Company. To quote from the commission's decision:

"We must, however, consider the needs of the communities and interests served, and their showing as to future prospects of traffic for the railroad. Although the testimony as to these prospects is conflicting, we are sufficiently impressed with the representation of the protestants to afford an opportunity to test their prediction. Accordingly, we will deny the application for abandonment without prejudice to its renewal by the Colorado & Southern after the expiration of 36 months from the date hereof, if it can be shown then that the situation has not materially improved."

That puts it squarely up to the mining industry. Tonnage must be substantially increased in the next three years, or undoubtedly abandonment will then be permitted. Indications point to an appeal by the Denver Water Board, but the railroad is not expected to appeal.

■

Mergers Stimulate Interest in Minnesota Iron-Ore Areas

Pending consolidations of steel concerns, and the desire of the several companies to insure adequate reserves of iron ore, are believed by F. A. Wildes, Minnesota superintendent of mines, to have been responsible for the large number of prospecting bids received this season. The total of thirteen bids compares with only one bid made last year and is the largest since 1921. Awarding of the permits has been postponed because two bids of the same amount have been made for a single plot. All the bids ranged from 12 to 12.5c. royalty per ton of ore mined.

Under the state law, Mr. Wildes explained, bidders must make offers of the royalties they will pay if they locate ore on the lands. Bids are on the basis of ore containing 25 per cent iron, with a 5 per cent increase for each 1 per cent of richer ore produced. The successful bidders are allowed one year to prospect, and if they locate ore they may sign leases on the property. No extensions of prospecting permits are allowed, and bidders therefore must either lease at the end of the year or abandon their rights.

■

Mansfeld Hopes to Resume

Mansfeld Copper, largest German primary producer of copper, is negotiating with its workers for a settlement of the wage dispute that closed the mines, smelter, and brass works on June 2. The drop in the price of copper necessitated a cut in wages, if profitable operations were to be maintained, but the company's employees refused to accept it. The company hopes that the dispute will be settled soon, permitting a resumption of operations. In the meanwhile, the coal and lignite mining divisions of the company continue to operate.

Rain Permits Resumption of Smelting at Matehuala

Copious rainfalls have terminated the drought in the State of San Luis Potosi, Mexico, and operations, which had been suspended because of lack of water, have been resumed at the Matehuala copper smelter of American Smelting & Refining. Production had been interrupted for about a month. The plant handles about 1,000 tons of ore from the Dolores and Santa Maria de la Paz mines daily. Neither of the mines closed during the drought, but some curtailment was put into effect. The rainfall has also relieved the water situation at the A. S. & R. units in the vicinity of the city of San Luis Potosi.

No decision has yet been made by the smelting company as to further action on the options it holds over several properties in Mexico, including the D'Inguaran copper mines, in Michoacan. Because of the prevailing low metal prices, a decision is likely to be deferred for some time. Production is not being curtailed further at company mines, even though the price of silver has dropped recently, as silver is largely a byproduct.

Operation of the new 300-ton lead carbonate mill at Chihuahua, which was started early in April, has been satisfactory. The plant also produces a small amount of tin.

■

International Silver Congress to Meet at Mexico City

By order of the President of Mexico, the organizing committee of the World Silver Congress that is to be summoned in Mexico City, probably this fall, to study the international silver situation, will comprise representatives of the ministries of industry, commerce and labor, of finance, of foreign relations and of communications, and representatives of mining interests in the republic. The committee, which will make all plans preparatory to inviting silver producers, bankers and government officials of the world's leading silver-producing nations, started to hold its meetings on June 16.

The presidential decree also creates a National Mining Council that will study the mining situation as it affects Mexico and make recommendations as to modifications of Mexico's existing mining laws as well as the general policy Mexico is to adopt in the face of the present mining crisis.

Among the subjects to be discussed at the silver congress, it is understood, will be the project of standardizing the monetary systems of the world and thus stabilizing the silver market. Both the summoning of the world congress and the creation of the National Mining Council were recommended at the National Mining Congress, held in Mexico City several weeks ago.

Golconda Cuts Ore at 1,600 and Resumes Sinking

Wallace, Idaho, June 18.—Golconda Lead, having driven a crosscut to the orebody on the 1,600 level of its mine near here, has now resumed shaft sinking to 2,000 ft., and has also started drifting along the orebody, both east and west of the crosscut. In shaft sinking, a station will be cut at 1,800 ft. and a crosscut driven to the ore on that level before the shaft is completed to 2,000 ft.—the objective of the present development program. The Golconda shaft is sunk from the main haulage, or 1,000, level.

At 1,600 ft., the Golconda orebody proved to be 9 ft. wide, where crosscut, and showed lead, silver, and some zinc. The grade is the same as that proved at 1,400 ft., but the width is slightly greater than the average on that level. The length of the orebody at 1,400 ft. is 800 ft., and conditions at 1,600 ft. are such that the management expects the orebody to persist at depth both in length and width.

Golconda plans doubling the capacity of its concentrator, now 200 tons daily, when the development work is completed. The plant is shut down at present, because of low metal prices, and the date of resumption of production is uncertain as a result. Costs should be cut when a larger tonnage is handled, however, and the company hopes to be able to start milling after the proposed expansion is completed.

Square Deal Mining, which owns a group of ten claims adjoining the Golconda mine on the east and covering the extension of the Golconda vein, has extended an option of half its capital stock to the Golconda company. Starting Jan. 1, Golconda agrees to spend $15,000 annually for five years to develop the Square Deal property from the Golconda workings. No ore has been developed in Square Deal ground, but it is regarded as a valuable property because of its proximity to the Golconda.

■

San Juan Shipments at Good Rate Despite Shutdowns

Production from mines in San Juan County, Colo., continues at steady rate, although two of the smaller mines stopped producing. In May, Sunnyside shipped 100 cars of zinc concentrate; 70 cars of lead concentrate; 13 cars of middlings, and 12 cars of iron concentrate. Shenandoah-Dives shipped 24 cars of concentrate, carrying gold, copper, silver, and lead. Colorado Mexico Mining Company shipped 9 cars of concentrate carrying values in copper, gold, silver, and lead. Vertex and Altamont did not ship in May. The total of 228 cars compares with 233 in April.

■

New Tariff Bill Signed

President Hoover signed the new tariff bill at Washington on June 17, thus putting the readjusted rates voted by Congress into effect on June 18. In our issue of May 7, a table of the principal changes in metal rates was published. Of greatest significance to the mining industry, probably, were the increases in the rates on manganese and the extension of the zinc tariff to low-grade zinc ore. The proposed tariff on silver, amounting to 30c. an ounce, was dropped in the conference committee on May 21, after the House of Representatives had defeated it, although it was originally passed by the Senate.

■

C. & H. to Add Power Unit at Its Ahmeek Mill

Calumet & Hecla Consolidated will increase its power facilities by erection of a plant at the Ahmeek mill, in the Michigan copper district. It will be supplementary to the main power plant at Lake Linden. A contract has been let to Stone & Webster, of Boston, who designed the plant, to erect the building and install the machinery. A 7,050-kw. high-pressure turbine will be installed. The power will be used for general purposes, both on the surface and underground. The work will be pushed to early completion. This is one of the few contracts the company has awarded outside firms, as Calumet & Hecla usually does its own work in this respect.

■

University of Utah Awards Six Mining Fellowships

From a list of twelve applicants for fellowships in the department of mining and metallurgical research of the University of Utah, the following appointments for the years 1930-31 are announced by the authorities of that institution: John Koster, Purdue University; D. W. Forsgren, University of Utah; Glen Burgener, Penn. State College; Otha Clyde Jones, University of Utah; Hillary W. St. Clair, University of Utah; and Roger Loofbourow, University of Utah.

Mr. Koster will continue in X-ray investigations of minerals, and D. W. Forsgren will be engaged to study the possibilities of producing weed eradicator from mineral waste. The remaining four fellows will be assigned to flotation and microscopic research departments, under R. E. Head, chief microscopist; A. L. Crawford, assistant microscopist; John Gross, metallurgist; W. E. Keck, associate professor of metallurgy; and R. L. Kidd, ore-dressing engineer.

Decide to Equip Kansanshi for Copper Production

London, June 19. — The Rhodesia-Katanga Company's report, just released, shows the intention of the company to equip its Kansanshi mine for production. This property was reopened in 1927, after having been shut down since the War. It was one of the first copper producers in Northern Rhodesia, having produced a considerable tonnage from a single water-jacket furnace up to 1914. When work was resumed, the company decided to attempt to prove sufficient ore for production on a large scale. The most recent estimate has shown about 1,500,000 tons of ore averaging 5 per cent copper.

Tests conducted under the direction of A. E. Wheeler, consulting metallurgical engineer of the company, have proved the Kansanshi ores amenable to modern treatment processes. Mr. Wheeler will design the plant. No announcement is made as to its size. A branch of the Katanga-Benguela railroad is planned to the property. It will involve laying 80 miles of railroad. The company's net assets at present are £360,000.

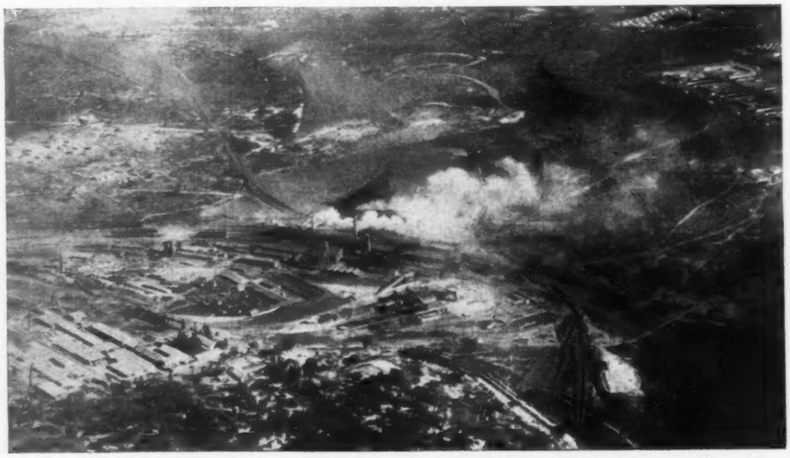
Recent development at Kansanshi has been favorable, the report indicates. Crosscuts driven on the 150 level reveal thirty fissures, with an aggregate width of 40 ft., that average 9.5 per cent copper and 1.5 dwt. in gold per ton. The large dolomite deposits have disclosed ore ranging from 9 to 13 per cent, with the schist orebodies near the fissures averaging nearly 4 per cent. Much of this ore will be available for extraction by open-pit methods, as contrasted with the underground mining that will have to be undertaken at most of the Rhodesian properties.

■

New Tin Dredge Not to Start

Talerng Tin Dredging, operating a property in Siam, will suspend all operations indefinitely in view of the crisis in the tin industry. The company has just completed a new dredge, which has a capacity of 200,000 cu.yd. monthly, or about 780 tons of tin oxide a year. The directors of the company, which is one of the Anglo-Oriental group, feel, however, that depletion of reserves under existing conditions would "serve no useful purpose."

Union Minière's Lubumbashi smelter, in the Belgian Congo



Main shaft of Combined Metals, at Pioche, Nev.

Amethyst Lease at Creede Suspends Operations

Since the recent sharp drop in silver, profits have been virtually wiped out at the Amethyst Lease, in the Creede district of Colorado, and the company has now suspended all operations except a little development work. Other operations at Creede are also feeling the decline in silver, and nearly all production has stopped.

Creede is one of the few camps in the United States which produces ore valuable almost entirely for its silver content. Even with present low prices, about 90 per cent of the value of all ore mined is accounted for by the silver content. Lead comprises nearly all the rest.

In 1929 the Amethyst Lease is reported to have produced 2,580 tons, with a gross value of $203,136.80, and net returns of $106,700.20, corresponding to an economic recovery of 52.5 per cent. The respective average grades per ton are $78.70 gross and $41.30 net. Nearly all of this was in silver with a few per cent in lead. The ore is of the oxidized and siliceous type. Development work was successfully prosecuted, and for the first few months of 1930 production was increased to 300 tons per month, although the average grade gradually decreased to 75 oz. silver per ton, with from 2 per cent to 3 per cent lead. In the middle of June shipments were suspended.

■

Five Deaths Result From Accident at Climax

Four men were killed immediately and three injured (one of whom died later) by a cave-in early in June at the Climax Molybdenum mine, at Fremont Pass, in Colorado. The accident occurred at the breast of the Phillipson tunnel, about 2,000 ft. from the portal and 450 ft. below the main workings. This tunnel is being driven for development purposes, and is expected to open up a large tonnage of ore. It has been in wet and heavy ground nearly all the way, and massive timbering has been used throughout.

The night shift was finishing a round of holes, preparatory to loading them with dynamite, when the back suddenly gave way and several tons of rock smashed through the timber roof. It is understood that those injured were down below, under the timbers, while several others who were standing on the timber, but fortunately back of the cave-in, were not hurt.

Several cave-ins had occurred previously in the Phillipson tunnel, but no one has been injured heretofore. The 12x12 timbers used have several times failed under the heavy rock pressure.

■

Start Reopening Rico Line

Reopening of the Vance Junction branch line of the Denver & Rio Grande Southern Railroad, which connects the silver-lead-zinc district of Rico, Colo., with Utah smelters, has been begun. The Ames slide, which has covered the track for more than a year and has stopped direct shipment of ore from the camp, is now being removed. Occasional shipments of ore have been made by Rico mines over the long route, through Durango to Salt Lake. Rico Argentine recently shipped about 100 tons carrying high zinc and lead content.

■

Round Mountain Activities

With construction of the new Gold Hill Development cyanide plant under way, 4 miles from Round Mountain, Nev., the camp has become quite active. Under the direction of L. D. Gordon, the Thomas F. Cole interests have started a new two-compartment shaft on the Nevada Gold Porphyry holdings. Gold Zone, which adjoins Gold Hill Development, is also sinking a new shaft, and Gold Hill Consolidated, to the north, is prospecting its ground.

H. A. Johnson is in charge of construction of the Gold Hill Development plant, which is expected to be in operation by Aug. 1. Concrete foundations have been laid and the crushing and grinding equipment has been installed. The cyanide tanks have been built. Capacity of the new plant will be 100 tons of ore daily.

■

Sarita Cyanide Plant Finished

Construction of a 50-ton cyanide plant for the Sarita Mining & Power Company, at Masonic, Calif., has been completed. Collins Western Corporation, Inc., built the plant.

Pioche Railroad Purchase Is Step in Area's Expansion

Recent purchase of the Pioche Pacific Railroad, operating a 15-mile narrow-gage railroad between Pioche and Jackrabbit, Nev., by Bristol Silver Mines, is an indication of expansion of mining operations in the Pioche district by Bristol Silver, W. F. Snyder & Sons, Combined Metals Reduction, and other interests. The three organizations mentioned are closely allied, all the silver-lead-zinc ore that is produced at their mines being shipped to the Combined Metals concentrator at Bauer, Utah, for treatment. National Lead has a half interest in Combined Metals.

Acquisition of the Pioche Pacific line is expected to result in a saving of from 75c. to $1 a ton for the Bristol company. Ore from its mine is transported to the railroad loading station at Jackrabbit by a 2-mile cable tramway. Ernest Neilson, for the last twelve years with the railroad, will remain in charge, according to E. H. Snyder, manager of both Bristol Silver and Combined Metals companies.

Under the direction of Mr. Snyder, churn drilling has recently been done by Combined Metals over a wide area at Pioche. On the Bristol property, ore is being mined between the 500 and 1,200 levels. No work has yet been done below 1,200 ft., although the shaft has been sunk to 1,700 ft.

At a point 10 miles southwest of the Combined Metals mine at Pioche, control of the Forlorn Hope and Pan American properties, in the Comet district, has been secured by International Smelting, W. F. Snyder & Sons, and J. E. Jones, West Virginia coal operator. Shafts are being sunk to explore the Combined Metals bed, with which the large replacement orebodies of the Combined Metals mine are associated.

■

Work Goes on at Spruce Mountain Pending Railroad Decision

Development work on the properties of Missouri Monarch Consolidated, at Spruce Mountain, about 20 miles south of Tobar, Nev., on the Western Pacific Railroad, is being continued pending a decision on the construction of a branch railroad to the camp. No shipping is being done, however. Two tunnels are being driven—the Black Forest, at an altitude of 8,487 ft. above sea level, which is now in 3,200 ft. on the east side of the mountain, and the Broncho, at an altitude of 8,501 ft., which has been advanced 1,400 ft. on the west side. Portals of both tunnels are located so as to facilitate loading in the case of railroad construction.

Resumption of activities at the Monarch tunnel, 1,800 ft. south of the Broncho tunnel, will be started on July 1. The winze will be sunk from 200 to 400 ft. Under the present plan of development, the company will crosscut all the important vein systems on the property.

■

Engels Stops Work at Calaveras

Engels Copper has suspended work at the Calaveras Copper property, near Copperopolis, Calif., because of the low price of copper. Sinking of one shaft will be continued, however. Engels acquired the property about a year ago.

Nevada Quicksilver Output Now About 700 Flasks Monthly

With the exception of the copper producers at Ely, the most profitable branch of Nevada's mining industry today is quicksilver production. On June 15, 1930, production was at a rate of more than 700 flasks monthly. The important producers include the Nevada Quicksilver, B & B, Castle Peak, and Red Rock properties. Pershing Quicksilver, formerly one of the largest producers, has been closed since March, as the company has a stock of several hundred flasks of the metal on hand, which it preferred not to sell at the prices that prevailed earlier this spring. With the recent advance in the price to $120 a flask, operations may be resumed.

Nevada Quicksilver Mines, largest producer in the state to date, has recently opened some high-grade cinnabar on its Juniper property. Production is consequently expected to be higher without any additions to the present capacity. The company now controls three mines, all at Antelope Springs—the Juniper, Montgomery, and Cinnabar mines. Total production to April 30, 1930, was $490,385. Operating costs were $79,975 and development work involved an outlay of $244,909, leaving a gross profit of $166,501. The total cost of the property and plant equipment was $195,894, indicating that the company has virtually liquidated its entire capital expenditure since production started in September, 1928.

In the same district, the adjoining Antelope Springs property has been leased to J. W. Hall, of Lovelock, and H. C. Newton and Sam Jay, of Los Angeles. Some high-grade ore is reported to have been developed, and installation of a Gould rotary furnace has been ordered. Production is expected to be about 100 flasks monthly.

B & B Quicksilver, operating a low-grade deposit near Mount Montgomery, Esmeralda County, is now handling about 140 tons of ore daily, having added a 4x60-ft. Gould rotary furnace and an improved cast-iron condensing system to its original 5-ft. kiln. The new furnace handles about 85 tons daily. Control of the property is now held by interests from Bakersfield, Calif.

Castle Peak, operating 16 miles southeast of Reno and about 6 miles north of Virginia City, has paid two dividends since starting operations in September, 1929. The company has 20,000 shares outstanding and both dividends have been $1 per share. Introduction of a new condensing system is expected to increase rate of production by about 20 per cent.

One prospect expected to come into production soon is the Bowers, operating 15 miles southeast of Gold Circle. A Gould rotary is now being installed. A rotary furnace is also being installed on the Raymond Van Ness property at Spanish Springs, about 15 miles east of Manhattan. A new company has been formed to operate a promising prospect, 15 miles south of Goldfield. Treadwell Yukon is still operating near McDermitt, but no statement as to production has been made recently. At one time it was announced that the mine was to be closed, but a new discovery was made and operations have since been continued by the company.

A new district from which much is expected is Dunlap Canyon, a few miles east of Mina. Mina Mercury is now under the control of Southern Mines, and a 25-ton rotary furnace is being installed. The Leighton property, on which an exposure of rich ore occurs, has been taken over by Childers and Rudolph, who have also acquired the Hite property. Tonopah Hasbrouck has bought ground between the two properties taken over by Childers and Rudolph and is extending a tunnel to hit ore about 100 ft. under a 40-ft. shaft that showed 1 per cent ore all the way down. Two other prospects in Dunlap Canyon are reported to be under development.

■

Tungsten Products Resumes

Tungsten Products, operating the old Nightingale property, 40 miles southwest of Lovelock, Nev., is again operating after a shutdown in April, caused by breaking down of machinery. A 220-hp. Diesel engine and other machinery have been installed. The mill is now treating 200 tons a day, on three shifts. The mine is on two shifts, with 40 men employed in mine and mill. Development work was carried on during the shutdown.

C. & H. Starts New Drilling South of Cliff Shaft

At its Cliff property in Keweenaw County, Mich., Calumet & Hecla Consolidated has started drilling on the bottom level, half a mile south of the shaft. This is the first hole to the south, and it will be put down to great depth. Holes north of the Cliff and Phoenix shafts were both put down more than 2,300 ft., the greatest depth drilled in Michigan. A sump has been put in at the Cliff shaft and the surface plant is being prepared to sink the shaft 1,000 ft. deeper. Crosscutting to the various amygdaloid and conglomerate beds in the hope of discovering the parent lode, believed to have been the source of the copper in the rich Cliff and Phoenix fissures, will follow.

At the company's Centennial No. 2 shaft, in which mining was started this year, about 400 tons of ore is being hoisted daily. Ground in the area near the bottom of this shaft was opened by the South drift on the No. 43 level from the North Kearsarge No. 1 shaft. Much interest is being taken in this development of the Kearsarge lode, as the bottom level is in the old Wolverine mine area.

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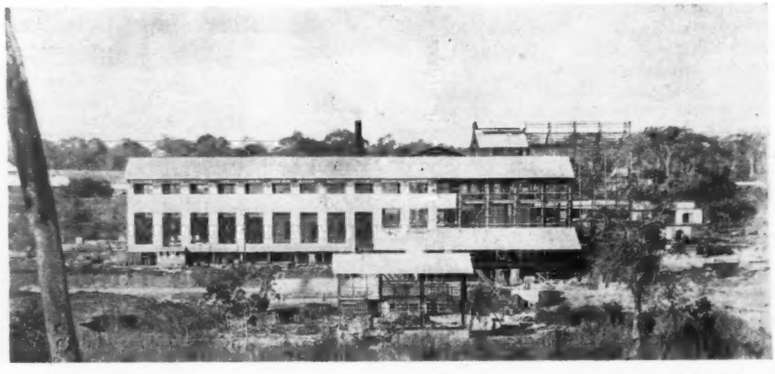


The new power plant nears completion at Roan Antelope, Northern Rhodesia

■ ■ ■

San Nicolas Closes Mill

Operations have been suspended at the 300-ton flotation plant of San Nicolas Mining & Milling, near Vicente Guerrero, Durango, Mexico, and only a small amount of development work is being undertaken in the mine. Even this work will be suspended unless the metal market improves, according to Henry B. Hanson, resident superintendent of the plant. The company had planned on installing a cable tramway from its San Francisco mine to the mill, but a provisional contract for erection of this unit had to be revoked when the drop in the silver market caused directors of the company to decide to postpone the expansion program.

■

Moscow Exploring Two Levels

Moscow Silver continues exploration of its property in the Star district, near Milford, Utah, on the 900 and 1,600 levels, and is shipping occasional carloads of ore from development work. Two carloads were shipped late in May. On the 1,600 level, the company is exploring the Mammoth fissure zone for downward continuation of the Moscow oreshoots in the central area of the property, and to the north a drift is following the Silver Bed in the hope of picking up an extension of the Red Warrior orebody. On the 900 level, the chief development work is a drift in highly mineralized territory, formerly developed at 1,100 ft. Leasers are driving a drift to open up the Old Glory stope.

■

Mazatlan Smelter Closed

Because of the decline in production from mines on the west coast of Mexico, as a result of the drop in the price of metals, operations have been temporarily suspended at the lead smelter of the Compañia Mexicana de Minerales, at Mazatlan, Sinaloa, Mexico. The plant has a capacity of about 100 tons of charge daily. Offices of the company will remain open in the hope that conditions will improve within a few months and that shipments to the smelter may be resumed.

At the Boliden mine of Skelleftea Gruv Aktiebolag, near Ronnskar, Sweden, which is now shipping ore to its new copper smelter. At the left are the company office and dwellings, and at the right is part of the open cut, with stripping operations in progress. In the background is the shaft headframe.

Princeton Geologists Plan 11,000-Mile Trip

An 11,000-mile trip throughout the United States constitutes the plan for the fifth annual expedition of the International Summer School of Geology and International Resources, according to an announcement made by Dr. Richard M. Field, of the Department of Geology of Princeton University, who will direct the trip. The party will be composed of twenty-three men, including five distinguished geologists and mineralogists from the United States and Europe.

The party will leave Princeton on June 25 in a Pullman car especially designed to accommodate the party and its work. According to the program, the work will keep the expedition in the field until Aug. 2. Twenty-one stops are on the itinerary, the principal localities to be visited being Johnstown, Pa., St. Louis, Tulsa, Fort Worth, the Grand Canyon, San Francisco, Coeur d'Alene, Butte, Anaconda, Big Horn Basin, Colstrip, St. Paul, Hibbing, Duluth, Detroit, Chicago, and Niagara Falls. The main purpose of the study at these various points will be to give a practical demonstration of the relation of geology to natural resources and problems of their utilization. Specific subjects for study are: Fuel and power; structural materials, both metallic and non-metallic; climate and agriculture; physiography; and transportation and trade.

■

Beralt Completes New Mill for Portuguese Tin-Wolfram Ore

Construction of the new 120-ton mill of Beralt Tin & Wolfram, near Silvares, Portugal, has been completed and the new cable tramway built by Ropeways, Ltd., has been put in service. In addition to the mill, the company has installed three Petter oil engines, generating 440 hp., and two new air compressors with a total capacity of 1,850 cu.ft. Developments in the mines have been favorable, and the company estimates costs at £70 per ton of wolfram, including all administrative and shipping charges. Tin can be produced profitably at £120 per long ton of fine tin.

■

Tombstone Ex. Mine Optioned

An option on the Tombstone Extension lead-silver mine, in the "No Account" district, 2 miles southeast of Tombstone, Ariz., is reported to have been given to the Guggenheim interests, of New York. The property is an old one, but it was recently reopened by a syndicate having a capitalization of $100,000 and consisting of H. d'Autremont, of Tucson; C. d'Autremont, of Chicago; and W. E. Holt and H. W. Hasselgren, of Tombstone. About 25 tons of ore daily has been shipped from recent development work. A new strike was recently reported in sinking the shaft at a depth of 142 ft.

■

McIntyre Porcupine to Build 2,000-Ton Flotation Plant

McIntyre Porcupine Mines, second largest gold producer in the Porcupine district of Ontario, will build a 2,000-ton flotation plant to replace the present 1,500-ton cyanidation mill. This decision has been reached following extensive experimental work in a 200-ton pilot mill constructed last fall. J. J. Denny, superintendent of the McIntyre mill, is responsible for the evolution of the process, which represents a radical departure in the treatment of Ontario gold ores. Cost of constructing the new plant is not known as yet, but it will be built near the No. 11 shaft, now the main hoisting unit, north of Pearl Lake. The present mill is south of Pearl Lake. Production, now about $4,500,000 annually, is expected to range between $5,500,000 and $6,000,000.

■

Leasers at Work in Tonopah

Despite the low price of silver, a total of 26 leasers are now at work in the Tonopah Belmont property, at Tonopah, Nev. The first carload shipment of ore under the leasing system was made on June 16, by Truscott & Wiley, who are reported to have opened a 5-ft. shoot of shipping-grade ore. Three other leasers are working in good grade ore, but they have not yet shipped any material. The ore will be sent to the Desert mill, at Millers, Nev.

■

Will Survey Ontonagon Area Held by Mohawk

A dip-needle survey of Michigan mine lands in Ontonagon County, Mich., which will be made this summer for Mohawk Mining by field men of the Michigan College of Mining and Technology, should be of valuable assistance to Mohawk in planning future development of the Butler and other lodes. The survey will cover about a mile square. Sinking in "E" shaft at Michigan is down to the 11th level. The ground still is quite badly faulted and requires considerable timbering. This is slowing up the work of lowering the shaft.

Con. Coppermines Continues Shipping 3,150 Tons Daily

Consolidated Coppermines, operating in the Ely district of Nevada, continues to mine and ship the maximum tonnage provided for in the existing contract with Nevada Consolidated to the latter's metallurgical plants at McGill—3,000 tons of 1.2 per cent porphyry ore and 150 tons of 8 per cent direct-smelting ore daily. Consolidated Coppermines has equipped its mines to produce triple this tonnage were metallurgical facilities available. The company has been considering construction of a concentrator and smelter of its own.

All the porphyry ore is now being hoisted through the new Emma-Nevada shaft, sunk and equipped within the last three years, and the smelting ore is coming from the Alpha shaft. Operations at the Morris-Brooks, Old Glory, and Richard shafts have been completely suspended. Development work done since the issuing of the annual report in the middle of April is said to have continued to yield favorable results. Porphyry ore reserves have been increased about 2,000,000 tons to 32,000,000 tons, or an addition in two months of two years' supply at current rates of extraction. Churn drilling is still in progress and further additions to reserves are expected, as estimates include only ore blocked out, whereas ore has been struck in several isolated holes. High-grade ore has been struck in several faces from the Alpha shaft and drifts are being driven into Richards shaft territory.

■

Big Jim Retimbering Shaft

Work of retimbering the Big Jim shaft, near Oatman, Ariz., is now down to about 250 ft. and will be continued until the 300 level station is reached. The shaft timbers were destroyed by fire during the period when United Eastern operated the property. When the 300 level is reached, the company intends doing development at that level and also at greater depth through existing winzes. The mine has not been worked below 600 ft.

At the neighboring Tom Reed mine, the crosscut on the 1,100 level has been driven more than 400 ft. toward the high-grade gold ore opened up at 950 ft. A heavy water flow is hampering operations somewhat, although the company's pumping equipment is sufficient to handle the volume of water. The 950 level has been connected on the east with the 1,000 level of the United American workings, and better ventilation is therefore available.

Mackay Metals Hopes to Cut Ore Below Present Bottom

Operations of the Mackay Metals property, near Mackay, Idaho, are being centered on driving of the new Cossack tunnel to cut the ore-bearing formation 600 ft. below the 1,000 level, the deepest level in the mine at present. Some copper ore is being mined in the upper workings and is either being treated in the flotation plant or shipped direct to the smelter. The Cossack tunnel is now near the point where raising will be started. Sinking from the 1,000 level will be undertaken simultaneously to expedite the work. Completion of this tunnel, which has now been driven about 6,000 ft., will enable a reduction in operating costs and will permit exploration of the ore zone at greater depth. Some mineralization has already been struck in the face of the tunnel.

The Mackay Metals property, formerly known as the White Knob or Empire Copper, has been the most productive copper mine in Idaho. After being exploited for about forty years by various interests, it was acquired in 1928 by a syndicate composed of A. J. Anderson and W. E. Narkaus, British Columbia mining men, and Chase Clark, Mackay attorney, who organized the present company. Recently, W. E. Hayes, of California, has been elected president. J. R. Weber is general superintendent.

After rehabilitating the property, the present company proved the continuation of ore to greater depths by drilling. In 1929, a total of 66,573 tons of ore was mined and 20,000 tons of concentrate and crude ore was shipped to smelters for treatment. Total value of production was about $497,000. A 3-mile cable tramway is used to connect the upper workings of the mine with the mill, which is on a railroad siding.

Several stopes have been opened on the 1,000 level during the last year. The orebodies occur on a granite-limestone contact and are not usually connected. The average grade of ore is better than 3 per cent copper. In addition, the company has a body of oxidized material, carrying 2 per cent copper, which has been proved by several tunnels to be of considerable size.

■

Oploca Installing New Pumps

Sinking of the new Pacheco shaft has reached a point 140 m. below the Oploca tunnel, in the Chocaya silver-tin district, Bolivia, according to the annual report of Compañia Minera y Agricola Oploca, recently released. New pumps are being installed on the No. 23 level to permit unwatering of the mine and continuation of shaft sinking. At present about 90 liters per second, or 1,400 g.p.m., is being handled by the pump installation in the mine. Development of the Colorado oreshoot has been completed on the Nos. 20 and 21 levels, and it has been found to compare favorably at these depths with ore on the levels above.

Ore reserves in the Oploca properties totaled about 219,000 metric tons of ore, containing 9,390 tons of fine tin, at the end of 1929. Although production last year averaged about 250 tons of ore daily, the company has curtailed output 20 per cent in agreement with the policy of the British Tin Producers' Association.

Compressor plant at mouth of Mackay Metals mine, in Idaho

Isle Royale Tailing Area

A plant to pump the tailing from the Isle Royale Copper mill, near Portage Lake, Mich., to the eastern edge of the present deposit has just been completed. Tailing formerly ran by gravity into the lake, but the available area has now been filled and the company has been forced to elevate its tailing to a tract of land that it owns. Machinery is being installed in the mill for dewatering the coarser tailing, which will be stacked north of the mill. Changes and installations in the mill to permit this classification as well as increased regrinding with flotation treatment will take until fall or possibly even early next year.

■

Find Copper Near Stikine River

Boats going up the Stikine River are well loaded with prospectors as a result of the discovery of a 30-ft. vein, grab samples from which are reported to assay $49.44 in copper and $3.20 in gold per ton. George Drapich, an old Yukon miner, made the discovery, which is on the west bank of the Stikine, about 100 miles above Wrangell, Alaska. More than 30 claims have already been located. Mr. Drapich is making a trial shipment of 15 tons.

■

Seven Troughs Testing Mill

Most of the machinery in the new Seven Troughs Gold mill, at Lovelock, Nev., has been turned over for testing. The cyanide tanks have been filled with water to soak and stop leakage before filling with solution. Operation of the entire 100-ton plant is expected to start on July 1.

■

Bassett Talks to Michigan Section

W. H. Bassett, president of the A.I.M.E., delivered the principal address at a meeting of the Upper Peninsula of Michigan section of the Institute, held in Houghton, Mich., on June 11. William Kelly, of Iron Mountain, is chairman of the section. The attendance at the meeting was large, and included many members' wives.

Tocopilla Will Build Mill at Panulcillo Properties

Sampling of the Inagotable mine, in the Panulcillo group of properties that Tocopilla Mining has acquired in Coquimbo, Chile, has shown an orebody large enough to justify construction of a 100-ton flotation plant. The mill is being built to permit expansion of capacity in case development on levels other than the two now unwatered indicates an increase in reserves. Only the Inagotable ore has been taken into account in constructing this plant, although several other properties are included in the group. The San Gregorio tunnel is also being cleaned out. On the Panulcillo dumps are 700,000 tons of low-grade ore, which the company may be able to treat profitably.

At the Tocopilla mines, in Antofagasta, ore reserves are now estimated at 55,150 metric tons averaging 15 per cent copper and 135,850 tons of about 4 per cent copper. Capacity of the milling plant has been increased to about 250 tons daily, by the addition of a third Traylor ball mill and K & K flotation equipment. The plant now makes a recovery of 91 per cent of the total and 95 per cent of the sulphide copper content.

■

Mellon Institute Plans New Research Building

The Mellon Institute of Industrial Research, at Pittsburgh, Pa., will increase its facilities by the construction of a new building. The new structure will be designed on classical lines—a plain, simple, but massive, structure, surrounded by columns. The present home of the Institute, completed in 1915, given by Andrew W. and Richard B. Mellon, was expected to provide adequate space for growth for many years; but for ten years the Institute has had a waiting list of companies, often almost as long as the roster of companies whose problems were being investigated.

In addition to providing more laboratories, the new building will give more commodious quarters for the general departments. A new library is planned to accommodate 250,000 volumes. The present department of research in pure chemistry will be expanded and facilities for pure research in other branches of science will be provided. Much more elaborate chemical engineering laboratories will be available in the new building. The fellowships in each specific field will be grouped in suites of rooms, so that the best use can be made of general apparatus adapted to their needs. Certain rooms will be equipped for specialized phases of experimental technique, such as electrochemistry, spectroscopy, low-temperature studies, radiations, and high-pressure experimentation. Other special features to be included are a large lecture hall, a dining hall, an industrial fellowship museum, and an underground garage.

The new laboratory structure, about 300x400 ft., will be seven stories high, with monolithic columns along all four sides. Its main entrance, on the third floor, will be reached by steps extending along the entire front of the building. The laboratories will face on interior courts. The design of the new building will be such that additional laboratory suites can be constructed in the interior courts without marring the beauty of the general appearance and without interfering in any way with the original laboratory units.

C. M. & S. Prepares to Drive New Tunnel at Molly Gibson

Consolidated Mining & Smelting is making preparations to reopen its Molly Gibson mine, near New Denver, B. C., which, except for small production by several different groups of lessees, has been idle since 1918. The mine is equipped with the usual mining machinery and a small mill. During the War, Consolidated took out a considerable tonnage of ore, carrying principally gold and silver, accompanied by pyrite and sometimes small amounts of galena and sphalerite. The company is building a new camp, lower down the mountain, and a flume to bring water for power and milling purposes from Kokanee Creek, preparatory to driving a new tunnel, which is expected to cut the vein 1,800 ft. from its portal and about 1,000 ft. below the old workings. The vein will be explored from this level.

Through agents, Consolidated has taken up a considerable number of claims along Cultus Creek, a tributary to Kootenay Lake, where it is developing the Iva Fern group, having previously acquired an option on the stock of Iva Fern Mines. The company has closed its camp at Cedarvale, having gained the information sought on the deposit of phosphate of lime there, and has transferred the men to other points on the same belt of phosphate-bearing rock. The company has resumed the development of the Emerald group, on Sibola Mountain, where it has been exporing a promising deposit of silver-lead-zinc ore during the last two seasons by three adits on the side of the mountain.

■

Asbestos Plants in Africa and Canada Forced to Close

Because of the fall in the price of asbestos, operations at plants in Canada and Africa, the two principal producing centers, have been curtailed. In Canada, the Asbestos Corporation has closed four of its mills in Quebec and has put the other two on half capacity. The company plans to carry on essential development and geological work, provided holders of the general mortgage bonds consent to postponement of the payment of interest and sinking fund charges, thus permitting the company to use its available cash resources.

African Asbestos Trust, which had been producing from a pilot plant in the Carolina district, Transvaal, has suspended all operations. The company had a large acreage under control, which it acquired for £350,000, and reserves of asbestos were estimated at 206,000 tons by W. F. H. Dudgeon in June, 1929.

■

New Mill for Hornsilver, Nev.

Construction of a mill at the Calavada Mining property, Hornsilver, Nev., is planned by Ohio Mines, which recently took over the mine. The company is backed by Cincinnati interests. A power line will be extended to the property from the Nevada-California Power Company, at Goldfield, a distance of 28 miles. Estimates had been prepared for Diesel power also, but the transmission line was believed more economical in the end because of the necessity of trucking fuel oil for a Diesel plant. Total cost of the mill and power line is estimated at $82,000 by Albert Silver, metallurgical engineer, of Tonopah, who designed the plant.

■

Base Metals Delays Increase in Mill Because of Market

Although development has added to the lead-zinc ore reserves of Base Metals Mining in the Monarch mine, at Field, B. C., capacity of its new 350-ton concentrator will not be increased at present, because of the low prices of metals. Actually, the plant has a coarse-crushing capacity of 500 tons daily and has been built so as to permit increasing the tonnage to that figure by a few minor additions to the grinding and flotation sections.

Reserves of ore, which were about 400,000 tons when production started last November, are now said to be close to 500,000 tons. The West Monarch orebody is thicker and of better grade in new faces opened up to the west. Lead predominates in the lower part of the deposit, and zinc in the upper. At present only the lead concentrate is being shipped regularly, finding a market at the A. S. & R. smelter at Selby, Calif.

Omineca Dredge Ready After Long Delay in Shipping

George W. Otterson, placer operator of Seattle, Wash., is completing erection of a dredge and will be ready to operate on the Otterson leases, Manson Creek, in the Omineca district, B. C., late this month. The machinery for the dredge has been en route from the railroad, a distance of 180 miles, for the last five years, owing to unfortunate delays caused by early thaws on the trail. The dredging ground is known to carry pay dirt, but in the past no machinery has been available for working it. Pay material is distributed through the ground, which has a depth averaging from 12 to 16 ft.

■

Granby Drops Option on Hanna

Granby Consolidated has relinquished its option on the Hanna group of sixteen claims, adjoining its own Hidden Creek mine, near Anyox, B. C. A Radiore survey of the Hanna group was made, and subsequently some diamond-drill holes were put down. Development at the Bonanza mine of the company, in the same district, continues favorable. Ore is shipped to Anyox over a cable tramway.

■ ■ ■

Canadian Copper Expansion to Reach Peak This Year

In 1929, Canada's production of copper was about 124,000 tons, the highest output on record. By the end of 1930, the Dominion's copper industry will be in a position to produce 275,000 tons annually. This tremendous increase will be made possible by the completion of construction work at the Frood, Flin Flon, Noranda, and Sherritt Gordon properties. As no other important additions to Canada's copper-producing capacity are now under way, at least a temporary halt will probably be made in the expansion of the industry when the 275,000-ton mark is reached. Recent copper discoveries at Opemiska and Great Bear Lake indicate that it may be only temporary.

The accompanying table lists ore reserves, present output, and potential capacity of the six important Canadian copper mines. In addition to these mines, properties that will probably contribute to Canada's copper output include the Amulet, Abana, Aldermac, and Waite-Ackerman-Montgomery, in Quebec; the Treadwell Yukon, Sudbury Basin, and Falconbridge Nickel properties, in Ontario; the Mandy mine, in Manitoba; and the Coast Copper mine, in British Columbia. Their addition to the production of the six major properties is not likely to be very large, particularly since the four Quebec mines will probably ship to the Noranda smelter, and their output will therefore be included in the 50,000-ton capacity of that plant.

Data used in compiling the ore reserves are all official figures for 1929, with the exception of those for the Britannia mine, for which no estimate has been made since 1926. Inasmuch as mill capacity at Britannia has recently been increased, the assumption that the amount of copper contained in the ore reserves has at least been maintained is a fairly safe one. Actually, a campaign of exploration is now under way that may result in adding 1,400 ft. of depth to the orebodies and thus effecting a very large increase in reserves. In several cases—notably the high-grade reserves of International Nickel's Frood mine, and Hudson Bay's Flin Flon property—substantial additions to present reserves are expected, but even without them the total of more than 5,000,000 tons of copper contained in the present reserves assures almost twenty years of life to Canada's copper industry at the proposed rate of exploitation.

Company	Ore, Tons	Grade (Per Cent Cu)	Copper Content, Tons	Output, Tons 1929	Output, Tons Potentia
Int. Nickel	43,562,000	3.62	1,576,944	40,000 (b)	120,000
	159,058,000	1.5 (b)	2,385,870		
Noranda	3,426,000	7.53	247,977	25,800 (a)	50,000(a
	3,000,000	2	60,000		
	238,000	1	2,380		
Hudson Bay	18,000,000	1.71	307,800	.....	15,000
Granby Con	14,341,970	1.81	259,600	30,400	32,500
Sherritt Gordon	5,254,500	2.5	131,362	.....	15,000
Britannia	10,000,000(b)	1.3 (b)	130,000	21,500	25,000
Totals			5,102,033	117,700	257,500

(a) Includes custom ore. (b) Estimated.

EXCLUSIVE

CABLES

FROM CORRESPONDENTS IN THE PRINCIPAL MINING CENTERS

Witwatersrand Shatters All Output Records in May

Johannesburg, June 14, 1930.—In May, the Witwatersrand district produced more than 900,000 oz. of gold. This output sets a new high-water mark for monthly production and indicates what the improvement in the native labor situation has done for the mining companies. The previous record for the entire province of Transvaal was 889,601 oz., including about 40,000 oz. of gold from mines outside the Watwatersrand. Figures for these mines in May are not available, but when they are added, indications are that total production for the province was almost 60,000 oz. more than has ever before been recorded in any one month. As the first quarter of the year had already shown a substantial improvement over 1929, the prediction that the Rand will produce at least 10,000,000 oz. of gold and all Transvaal more than 10,500,000 oz. in 1930 appears a conservative one. In 1929, Rand production was 9,980,713 oz. and Transvaal production reached the record total of 10,414,066 oz.

. . . . Government Areas, largest producer of the Rand mines, reflected the general prosperity of the district. Preliminary estimates for profits in May place the net at about £240,000, which is the greatest monthly profit ever obtained by a Rand mine. Last year the mine's average monthly profit was about £225,000.

. . . . Steps are now being taken to secure the continuation of the tremendous output of the Rand. The Union of South Africa government has announced the appointment of a Low-Grade Mines Commission, which will be composed of representatives nominated by the Transvaal Chamber of Mines, the mine workers, and the Union government. This commission will deal with the problem of making possible the treatment of the 440,000,000 tons of junore that Sir Robert Kotze has estimated are contained in the Rand deposits. It carries from 3.5 to 4.5 dwt. in gold.

. . . . At the annual meeting of South African Townships, the holding company of the Bailey interests, the chairman of the board of directors explained the reason for the failure to declare a dividend in 1929. He stated that the directors pursued a cautious policy in conserving the company's cash reserves because of the world-wide financial depression of 1929. The company paid a dividend of 10 per cent in 1928. Its chief interests are in South African tin, diamond, and platinum mines and Rhodesian gold properties.

■ ■ ■

Roan Increases Rate of Mine Development Work

London, June 18. — Roan Antelope is now driving about 2,700 ft. of mine openings monthly, or at the rate of about 6 miles a year, thus insuring availability of sufficient stopes to supply the 5,000 tons of copper ore daily that will be required by the flotation plant now being built and expected to be in operation in 1932. The increased speed of the mine work is due largely to the rapidly growing efficiency of the colored labor employed. Doubts had been cast on the ability of the Northern Rhodesian workers to accustom themselves to mine work, and this improvement is therefore regarded by mine executives with more satisfaction than the increasing numbers of men available. The Roan issue of £1,500,000 in 7 per cent debentures has been completely subscribed for, insuring adequate capital for the construction program, which is making excellent progress.

. . . . The temporary 1,250-kw. power plant at the Mufulira Mines property is now in commission, and work has been started on construction of the permanent plant, as well as sinking of the new main operating shaft. At the Chambishi property, owned by Rhodesian Selection Trust, which is controlled by the same interests as Roan Antelope and Mufulira, drill hole No. 35, the deepest yet put down on the property, cut 25 ft. of ore at a depth of 1,180 ft. The ore averages 6.85 per cent copper and is the highest grade found at Chambishi over so great a width. The hole is about 1,000 ft. southwest of No. 23, which cut 55 ft. of 3.63 per cent copper. Drilling at Baluba, which adjoins the Muliashi area of Roan Antelope on the east, has been stopped by Rhodesian Selection Trust, and the drills are being sent to other of its grants in the N'Kana Concession. About thirteen holes in all were put down at Baluba, and all but three cut ore of about the same grade as at Roan Antelope.

. . . . Rhodesian Anglo American is issuing 600,000 shares which will be offered to stockholders at 30s. each. Anglo American of South Africa is underwriting the entire issue without commission. The funds are being raised to extend the company's interests in Rhodesian copper companies.

. . . . Sir Edmund Davis, who is interested in nearly all the Rhodesian companies, recently made the interesting estimate that by the end of 1930, drilling would have proved the existence of a total of 585,000,000 tons of ore, averaging 4.25 per cent copper. Operating costs, one of the biggest bones of contention in current discussions of the district, he puts at £37 10s. (8.13c. per lb.), c.i.f. European ports, per long ton of copper of "best selected grade." Roan, N'Kana, and Mufulira will enter production in that order, he believes, and their initial production will be at the rate of about 190,000 tons annually.

Steady Increase in Stocks Worries Tin Producers

London, June 14.—Hopes alternate with fears in the immediate tin position. All the important tin producers appear to be co-operating amicably in the restriction program, and yet stocks of the metal continue to increase. At least five unfavorable points are mentioned in connection with the present situation: (1) All Chinese-owned tin mines are not in the scheme. (2) New companies, which have just equipped their properties and which cannot be prevented from starting production, are adding their output to supplies. (3) Investigations in the United States are reported to have indicated that, owing to depression in the automobile industry, consumption of tin in the United States this year will hardly exceed 62 per cent of consumption in 1929. (4) Some tin authorities predict a fall in the price to £120 a long ton, and of course these bearish utterances have a bad effect on the consumers. (5) The big problem is the unknown extent of stocks in the East.

. . . . All is not gloom, however. Some firms have been buying tin, which is considered evidence that they believe the bottom has been reached in the decline of the price. More than 1,000 tons of metal have been bought in the London market during the last week, with the result that the price has rallied to £139 a long ton. A new restriction plan has been proposed. Instead of spreading a 20 per cent curtailment program over a year, as is now the practice, the new plan is to shut down plants all over the world for two entire months, with the expectation that stocks will be completely liquidated in that period. A special committee, with representatives from every important tin-producing country, has been appointed. C. V. Stephens, F. A. Mair, John Howeson, Antenor Patiño, Martinez Vargas, F. G. Houwert, and J. Van den Broek are included in the membership, representing Nigeria, Malaya, Bolivia, and the Dutch East Indies.

. . . . Stockholders of Kagera (Uganda) Tinfields have accepted the offer of purchase made by Billiton, one of the two leading Dutch enterprises. Kagera has prospecting licenses over 330 square miles in the Uganda Protectorate, Africa, and is shipping ore from Mwirasandu.

. . . . Some shareholders in the smaller nitrate companies are protesting against the Cosana scheme, which would consolidate the entire industry into one organization. They allege that in addition to the £75,000,000 of ordinary stock, an issue of £47,000,000 in debenture stock will be necessary to finance the enterprise in accordance with the terms originally outlined. As for dividends, they point out that £4,360,000 in prior charges will have to be met out of profits annually before dividends on the ordinary stock can be considered.

MARKET AND FINANCIAL NEWS

U. S. Lead Production Shows Large Drop in May

Lead production of the United States showed a substantial drop in May, but so did shipments, and the American Bureau of Metal Statistics reports a consequent increase of about 7,600 tons in reported stocks. Although the output in May was only 3,000 tons less than in April, the fact that May is a longer month resulted in a decline of almost 10 per cent in the daily rate from 1,853 tons in April to 1,703 tons in May. In January, the daily rate of lead production was 1,613 tons, but with that exception the May rate is the lowest of the last two years.

U. S. Production, Refined Lead
(Short Tons)

Month	1929	1930
January	63,165	49,991
February	55,546	54,125
March	61,110	56,552
April	58,040	55,547
May	63,632	52,818

U. S. Stocks and Shipments, Refined Lead
(Short Tons)

	April	May
Production:		
Domestic ore	55,547	52,818
Secondary and foreign	8,520	6,352
Total	64,067	59,170
Stock at beginning	42,469	42,015
Total supply	106,536	101,185
Stock at end	42,015	49,638
Shipments by difference	64,521	51,547
Shipments reported	64,100	51,871

Silver Figures Still High

Production statistics for silver, although they indicate a drop from last month's figures, still show an output that is not far below last year's averages. Total world figures for March show a production of 18,343,000 oz., compared with 21,849,000 oz. in February and 16,653,000 oz. in March, 1929. Mexican production in March was 8,844,000 oz., compared with 12,717,000 oz. in February and 6,855,000 oz. in March, 1929. Figures are also available for May output from several countries. The figures in parentheses are April output. They include the United States, 4,375,000 oz. (4,627,000); Canada, 1,584,000 (1,705,000); Peru, 1,959,000 (1,467,000); and Australia, 706,000 (646,000).

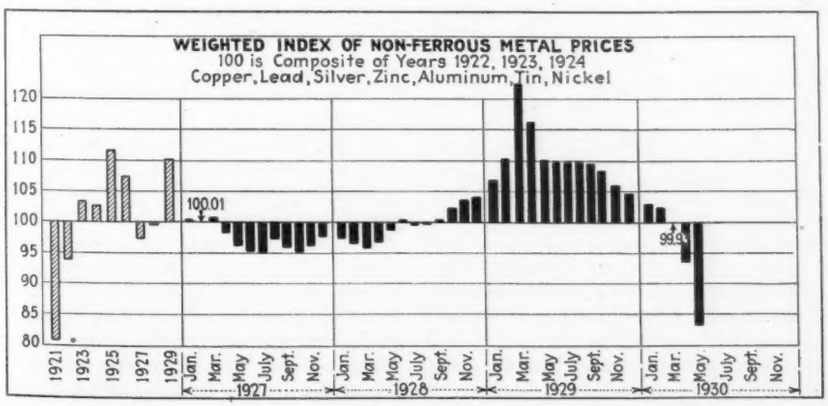
World Zinc Output Down

Figures on world production of zinc in May, just released by the American Bureau of Metal Statistics, show a total of 100,173 tons produced by reporting countries, as compared with 98,691 tons in April. Due to the longer month, however, the daily rate is down from 3,289 to 3,231 tons. March output was 105,253 tons. Production of some of the leading countries in May, April figures being given in parentheses, follows: United States, 43,991 (43,080); Canada, 9,204 (9,679); Germany, 10,060 (9,710); France, 9,223 (9,009); and Australia, 5,312 (5,133).

Canadian Mineral Output Continues to Increase

Data just released by the Dominion Bureau of Statistics show that Canadian production of many metals was considerably higher in the first four months of 1930 than in the corresponding period a year ago, in spite of the lower prices that prevailed and the more inactive condition of industry. A comparison follows:

	Four Months Ended April	
	1929	1930
Asbestos, tons	87,182	76,613
Copper, tons	37,737	51,978
Gold, oz.	605,618	632,487
Lead, tons	48,133	58,343
Nickel, tons	18,180	18,495
Silver, oz.	5,581,369	7,933,672
Zinc, tons	34,427	40,484



Little Change in Copper Production or Stocks

Refined copper stocks in the hands of producers in North and South America increased 7,308 tons during May, to a total of 308,646 tons. Blister, however, decreased 3,126 tons to 266,497. The total at the end of May, including stocks in Great Britain and at Havre, was 591,895 tons, compared with 588,103 tons a month before.

Shipments so far this year, in tons, have been as follows, these figures, like those in the foregoing, being compiled by the American Bureau of Metal Statistics:

Month	Domestic	Export	Total
January	69,932	30,358	100,290
February	61,879	29,597	91,476
March	73,644	30,523	104,167
April	50,017	29,196	79,213
May	75,760	49,115	124,875

Reported shipments were approximately up to production, but consumption was probably somewhat better than shipments indicate, owing to reduction of stocks at consumers' plants.

In the first five months of the year, 67.17 per cent of the total shipments of copper have been in the form of wirebars, 12.79 as cakes, 7.10 as cathodes, 4.55 as ingot bars, 3.43 as ingots, 1.54 as bessemer copper, and 3.42 per cent as other shapes.

To Great Britain has gone 28.62 per cent of the exports, to France 25.07, to Germany 14.72, to Italy 11.82, to Scandinavia 5.82, and to Canada 5.35 per cent.

The daily rate of world blister copper production in May, 4,735 tons, was the lowest since January, 1928, though representing a decrease of only 57 tons per day, or 0.85 per cent, from the April output, in spite of a reduction of 3c. in the average price received. Comparative total tonnages for April and May follow:

	April	May
United States	76,777	75,936
Chile and Peru	21,037	22,213
Europe	12,500	13,000
Africa	10,700	11,000
Canada	7,580	8,782
Japan	7,624	7,412
Australia	650	647
Elsewhere	3,000	3,000
Totals	144,298	147,352

As Europe consumed an average of 70,800 tons ot copper a month last year, according to the American Bureau of Metal Statistics, the recently reported threat that she will henceforth try to get along without American copper seems rather footless.

World Zinc Outlook Practically Unchanged

INTERNATIONAL METAL SERVICE, LTD., LONDON

Since the first day of May, nothing has occurred to lift the zinc market out of the trough into which it has fallen. Heavy buying occurred in the first half of May, coincident with the activity in copper, which caused prices to go up no less than 32s. 6d. within a week, but since then the price has dropped back, so that on June 11 the quotation was almost exactly the same as on May 1.

Since the cessation of the publication of the Belgian production statistics it has become more difficult than ever to gage production and consumption accurately, but it still seems evident that more metal is being produced than is being digested. The brass makers absorbed some of the accumulation of metal, but their buying did not come up to expectations, and, as most of it was High-Grade, the European retort smelters did not benefit much except from the sentimental effect of a drop in High-Grade stocks.

The demand from brass makers has now dried up, and the hope that it would improve with a drop in copper prices is, of course, no longer existent. Rollers have shown just a trifle more interest; as far as the German rollers are concerned, this may merely be a desire to insure against the possibility of a tariff on imports, which would be of no ultimate good, naturally, in increasing consumption. The slump in demand from galvanizers seems to be world-wide. All told, all the principal zinc-consuming countries seem to be calling for less than normal tonnages, and the cumulative effect is disastrous.

The tariff propaganda of the German zinc producers has recently been the chief item of interest. With adequate protection they claim it would be possible gradually to displace imports of both slab zinc and zinc sheets, respectively about 100,000 and 10,000 metric tons yearly, by domestic production. This would make a pretty marketing problem for the Polish zinc hitherto absorbed in Germany. German users are against the proposal, saying that no High-Grade zinc is being produced in Germany, nor can there be for the best part of two years to come. The rollers say that the supply of a suitable quality of zinc from German sources is utterly inadequate; and the exporters, promised a rebate on shipments of finished and semi-finished goods, hold that the proposal is impossible for technical reasons. The producers, thus rebuffed, have suggested that the duty should become inoperative when the price reaches £23 per long ton instead of £25, as first proposed. Initial meetings between the producers and consumers have been fruitless of result.

No interest is aroused in marketing circles by the rumors that American interests may yet co-operate with European producers looking toward restriction of production. This is getting to be an old story, and it is felt that first there should be some evidence that production is actually being curtailed as a result of the low price.

However, the feeling is gaining ground that prices can hardly go much lower, and some speculative buying has thus been aroused. It is felt that the downward trend in commodity prices in all countries may soon be arrested, and that zinc, particularly, has been deflated, with brighter days just ahead. An ounce of fact would be worth a ton of theory in this matter, however, and a definite decline in the arrivals of zinc ore would do more to induce a feeling that the corner was being turned than anything else. During the first four months of this year Germany imported 52,563 metric tons of ore, against 48,982 metric tons a year ago. Similarly, her exports are 65,553 metric tons for the present year, or slightly more than in the first four months of 1929, when they aggregated 63,536 metric tons. It seems pretty obvious that neither her smelter output nor her mining operations have as yet been more than discommoded by the price of zinc.

Our estimate of world stocks of zinc on June 1, 1930, follows:

	Metric Tons
United States	92,400
Canada, including afloat	4,100
Germany-Poland	18,800
Belgium	11,800
France	2,400
Great Britain	8,000
Other Europe	3,200
Australia, including afloat	4,000
Far East	1,500
Elsewhere	2,000
Total	148,000

This represents a gain of 6,800 metric tons during May.

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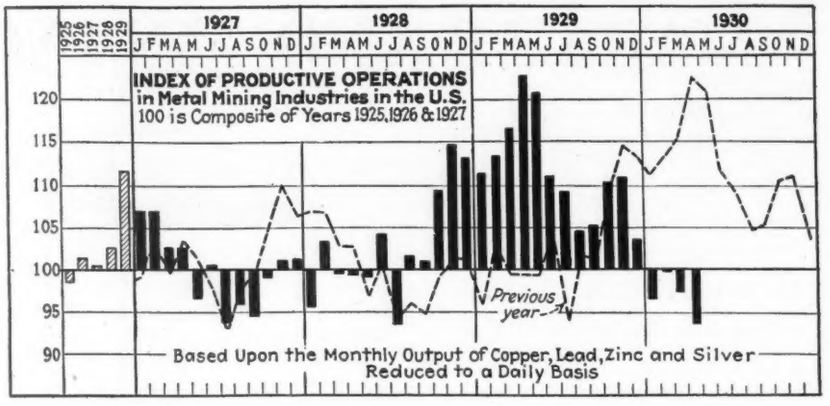
BURMA CORPORATION, operating silver-lead-zinc mines in India, has declared a final dividend of four annas and a bonus of two annas a share. This makes total dividend payments for the fiscal year thirteen annas, compared with sixteen annas in the preceding year. An anna is equivalent to about 2c. U. S. currency.



Michigan Copper Shipments

Copper shipments by boat out of the Michigan district in May amounted to 6,842,000 lb. Of this, Calumet & Hecla shipped 3,940,000 lb.; 2,692,000 lb. moved from the Michigan smelter, which treats Copper Range, Mohawk, Isle Royale, and Seneca concentrate; and 210,000 lb. was shipped by Quincy. Rail shipments were fairly good in May, accounting for more than 5,000,000 lb., but little copper business either by boat or rail has been done in the last few weeks. Nearly 80,000 tons of coal was received by the mines in May.

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Financial Notes

TINTIC STANDARD MINING, operating a silver-lead property in Utah, has declared its regular quarterly dividend of 20c. a share, but will not pay the usual extra dividend of 10c., thus putting the stock on a basis of 80c. annually.

CONSOLIDATED GOLDFIELDS of South Africa will absorb South African Gold Trust and Amalgamated Mining Trust on the terms made public late on May, the shareholders of the companies having approved the terms by large majorities.

FEDERAL MINING & SMELTING, operating lead-zinc mines in Idaho and the Tri-State district, reports a net income of $400,145 in the first quarter of 1930, compared with $801,298 in the corresponding quarter of 1929 and $288,731 in the last quarter of 1929.

NORTH BUTTE MINING, operating a copper-zinc property in Montana, reports $453,881 cash on hand on May 1, 1930. In the year ended March 31, 1930, the company shipped 88,350 tons of ore, with a net value of $604,630. The board of directors is meeting on July 2 to vote on an increase in capitalization from 1,500,000 to 2,000,000 shares.

SILVER KING COALITION, operating a silver-lead-zinc mine in Utah, will pay its regular quarterly dividend of 25c. a share on July 1. Silver King is probably the only one of the large Utah metal mines to maintain dividends despite the drop in metal prices.

Standard Statistics Predicts Earnings for 1930

The extent to which some of the leading non-ferrous mining companies have been affected by the current business depression is indicated by the 1930 earnings of these companies as forecast by the Standard Statistics Company. These predictions are based on earnings for the first quarter, or on known operations of the various companies. The estimated average earnings per common share during 1930 of 16 copper and brass companies is placed at $3.17, against $5.22 in 1929, and $4.32 in 1928. Miscellaneous metal mining and smelting companies, outside of copper, are expected to do a little better, seventeen of these companies being expected to earn on an average $3.21 during 1930, against $4.18 in 1929 and $3.26 in 1928.

Following is a list of these companies, with their 1930 earnings as estimated by the Standard Statistics Company.

Earnings per Common Share

	1928	1929	1930(a)
Aluminum Co. of America	7.09	11.18	9.00
American Metal Co., Ltd.	3.58	3.23	3.25
Amer. Smelting & Refining	8.24	10.02	7.50
Butte Copper & Zinc	0.31	0.34	0.15
Dome Mines, Ltd.	1.57	1.87	1.00
Federated Metals Corp.	3.29	3.67	1.50
Hecla Mining Co.	1.58	1.88	1.50
Hollinger Cons. Gold M.	0.76	0.74	0.75
Intl. Nickel Co. of Can., Ltd.	1.05	1.47	1.75
Newmont Mining Co.	14.08	22.24	15.00
Nipissing Mines Co., Ltd.	0.34	0.15	0.15
Noranda Mines, Ltd.	0.76	2.11	3.00
Park-Utah Cons. Mines	0.44	0.22	0.15
Patiño Mines & Ent. Cons.	3.78	3.31	1.00
Teck-Hughes Gold Mines	0.55	0.53	0.65
U. S. Smelt., Ref. & Mining	3.50	3.36	3.25
Vanadium Corp. of America	4.55	4.91	5.00
Anaconda Copper Mining Co.	7.38	7.83	4.50
Anaconda Wire & Cable Co.	4.80	4.77	3.00
Calumet & Arizona Min. Co.	9.22	9.18	4.50
Cal. & Hecla Cons. Cop. Co.	1.55	2.66	2.00
Cerro de Pasco Copper Corp.	5.13	4.21	6.00
General Bronze Corp.	3.61	4.01	3.50
Granby Cons. Mng., Sm. & Pr.	3.45	6.24	0.75
Howe Sound	5.34	7.38	4.50
Inspiration Cons. Copper	2.93	4.02	1.85
Kennecott Copper Corp.	5.01	6.10	4.00
Magma Copper Corp.	4.78	7.35	3.00
Miami Copper Co.	2.47	5.11	3.00
Nevada Consol. Copper	3.13	3.60	1.50
Phelps Dodge Co.	5.04	4.84	3.00
Revere Copper & Brass, Inc.	4.32	3.31	3.00
United Verde Ext. Mng. Co.	0.97	2.85	2.65
Amer. Zinc, Lead & Smelting	0.01	0.53	Nil
Bunker Hill & Sul. M. & C.	6.71	6.92	5.00
Cons. M. & S. Co., Ltd.	18.02	17.35	10.00
Evans-Wallower Lead Co.	0.18	0.46	Nil
Federal Mining & Smelting	24.15	36.00	25.00
New Jersey Zinc Co.	3.79	4.70	4.00
St. Joseph Lead Co.	2.30	3.82	3.00

(a) As forecast by Standard Statistics Company.

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Oploca Profits Up in 1929

Despite the drop in the price of tin in 1929, as compared with 1928, Compañia Minera y Agricola Oploca de Bolivia, operating a group of tin-silver properties near Chocaya, Bolivia, made a very substantial gain in its profits as a result of lower costs and higher production. The surplus from operations carried over to the balance sheet was £182,792, as compared with £131,144 in the preceding year. The company produced 2,866 metric tons of fine tin in 1929, compared with 2,657 metric tons in 1928. Costs were cut from £159 per ton of tin to £137 17s. per ton. The company paid £180,000 in dividends during 1929.

E.&M.J. Weighted Index of Non-Ferrous Metal Prices

100 Is Composite for 1922-3-4

1920	130.92
1921	80.80
1922	93.94
1923	103.43
1924	102.63
1925	111.74
1926	107.74
1927	97.54
1928	99.78
1929	110.33

	1928	1929	1930
January	97.54	106.86	102.94
February	96.73	110.37	102.28
March	96.22	122.71	99.93
April	97.14	116.36	93.24
May	99.05	110.03	83.41
June	100.16	109.66	....
July	99.69	109.58	....
August	99.85	109.81	....
September	100.53	109.29	....
October	102.34	108.52	....
November	103.83	106.09	....
December	104.28	104.75	....

Financial Notes

CASTLE-TRETHEWEY MINES, operating a silver property in Ontario, reports a net profit for the year ended March 31, 1930, of $78,407, compared with $199,125 in the previous fiscal year. Production was 831,307 oz. of silver and 37,834 lb. of cobalt, from the treatment of 45,302 tons of ore. In the previous year, corresponding output was 951,718 oz. of silver and 40,339 lb. of cobalt from 43,186 tons of ore.

CHRISTMAS COPPER, operating a property near Hayden, Ariz., made a net profit of $36,709 in the first quarter of 1930. Production was 1,577,700 lb. of copper, 238 oz. of gold, and 7,349 oz. of silver, from about 50,000 tons of ore.

ALASKA JUNEAU GOLD mined and trammed to mill 338,290 tons in May, from which estimated receipts were $273,500, or 80.85c. per ton; operating expenditures $175,000, or 51.73c. per ton, and operating profit was $98,500, or 29.12c. per ton. Other expenditures and accrued charges totaled $10,100, leaving to surplus $88,400 for the month. Indebtedness was reduced by $94,102, leaving unpaid balance of $610,000.

RHODESIAN ANGLO-AMERICAN, which has large holdings in Rhodesian copper companies and which is acting as consulting engineers to several of the mines, is increasing its capitalization from £3,500,000 to £5,000,000 by the issue of 3,000,000 shares of 10s. par.

ROAN ANTELOPE COPPER, operating a property in Northern Rhodesia, is issuing 7 per cent 15-year debenture stock. A total of £1,500,000 of this stock is being offered to complete financing of equipment of the mine.

International Nickel to Issue Additional Common Stock

International Nickel will offer to common stockholders rights to subscribe to additional common stock in the ratio of six new shares for each 100 held at $20 a common share. A special meeting of stockholders, to be held in Toronto, Canada, July 25, 1930, has been called for the purpose of increasing authorized common stock to 15,000,000 shares from 13,928,594 shares, to enable this offer of new stock to be made. It will place about $16,000,000 in the treasury, which, with present cash reserves, will enable the company to complete its expansion program at its plants in the Sudbury district and elsewhere, and still retain its present strong financial position as to working capital and cash.

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McIntyre Output and Profits Up in Last Fiscal Year

Increased gold production, resulting both from a larger tonnage and a higher grade of ore handled, was reflected in an increase in net profit of McIntyre Porcupine Mines, operating in northern Ontario, during the year ended March 31, 1930. Before depletion or depreciation, the company made a net profit of $2,072,300, compared with $1,093,314 in the previous fiscal year. Production was $4,457,001, compared with $4,212,625, and the tonnage treated was 550,495, compared with 538,165. At the end of the year, the company's surplus was $4,158,140, contrasted with $3,809,536 the year before and $3,563,555 two years ago. Current assets on March 31 were valued at $3,654,033, compared with current liabilities of $315,112. The company has general and depreciation reserves of $3,959,319.

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Tocopilla Mining in 1929

Operating profit of Tocopilla Mining, operating a copper property in the Province of Antofagasta, Chile, was 9,130,786 Chilean pesos in 1929. Total value of production was 13,988.751 pesos. The company paid dividends amounting to 5,800,000 pesos. Production amounted to 8,194 metric tons of concentrate, averaging 26 per cent copper and 2.6 grams of gold per ton, and 29,922 metric tons of shipping ore, averaging 15.8 per cent copper and 1.6 grams of gold per ton.

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Galvanized Sheets from U.K.

Exports of galvanized sheets from Great Britain in the first four months of 1930 totaled 203,709 short tons, against 318,673 in the same period last year.

Metal Prices Slump to Lowest Levels in Years, Stimulating Demand

New York, June 19, 1930—Non-ferrous metals, like most other commodities, and in sympathy with a violent downward reaction in the stock market, have dropped to new low levels in the last two weeks. Copper at 11½c., delivered, yesterday, was the lowest since 1914, when 11½c. was quoted on Nov. 5. Zinc, at 4.40c. yesterday, was the lowest since 1921, when a low of 4.125c. was registered on Aug. 30. Tin, at 29½c. on June 17, was the lowest since 1922, when 28¾c. was touched on March 16. Silver, at 33⅝c. on June 16, struck a new all-time low. Lead alone has maintained a respectable price, though dropping to 5.40c., New York, on June 17; in 1922 it was down to 4.70c., and in 1921 touched 3¾c. Demand for copper and zinc was stimulated by the recent price cuts, but the market has been quiet for lead, tin, and silver. Among the minor metals, another advance in iridium is the only notable feature.

Copper Drops 1½c.

The stability of the copper market at 13c., following a reaction upward from 12c. after heavy sales early in May, was short-lived. Custom smelters are no longer seeing eye to eye with the large producers in maintaining prices, but have gone back to their old practice of selling their intake from week to week for what the metal will bring. As there has been practically no demand since the May buying wave, when 137,000 tons was sold in the domestic market in one week, a gradual accumulation of supplies led some sellers to quote 12¾c. instead of 13c. on June 6, and since then, with further forced selling, the price structure has been weak, sales having been made as low as 11½c., delivered, yesterday. The large producers have not been willing to compete on even terms with the continued price cuts, but on some days, as when the price was 12c., have been willing to sell on a competitive basis, so that the custom smelters have by no means monopolized the business. Excellent business has been done in the last week, chiefly around 12c., and it seems likely that the pressure to sell has been relieved for the time being, with the possibility that all sellers will decide to quote 12c. until absence of demand, or heavy buying, influences a change down or up.

The next buying wave may come from abroad, as the foreign price has been consistently high since the domestic market became unsettled. With a return to stability at 12c. here, and 12.30c. abroad, which is the level that Copper Exporters, Inc., have been quoting the last three days, foreign buying may be encouraged, as the price should prove attractive. Copper Exporters quoted 13.30c., c.i.f. from May 12 to June 12; 13c. on June 13; 12.55c. on June 14, and 12.30c. June 16 to 19.

Copper fabricators report that demand from the ultimate consumers has been disappointing at the low prices now ruling, the general industrial depression being blamed. Much of the business that has been placed by copper producers therefore has been attributable to the desire of buyers to average down their intake prices, or as merely good speculation against an anticipated rise.

Lead Cut to 5.40c., N. Y.

The fundamental condition of lead is excellent, with no burdensome stocks, and with production pretty well in line with consumption. In the last two months, however, a decline in consumption has been evident, and the market has been rather quiet. Consumers generally have been buying from hand to mouth. This condition promises to continue for a week or so longer at least, so the American Smelting & Refining Company, on June 17, reduced its New York contract price to 5.40c. after maintaining it at 5.50c. since May 20. The chief factor in the Middle West, who has heretofore been at 5.40c., St. Louis, came down to 5.30c. Corroding grades command the usual premiums of $2@$3 per ton.

Galena in Joplin sold at $65@$70 in the week ending June 7, and at $65 last week, 80 per cent basis.

Zinc at 4.40c. Attractive

Zinc buying has improved considerably since sellers consented to break through the 4.60@4.70c. quotation that they maintained all during May and until June 10. A good tonnage was booked at 4½c., and the general offers now being made by all producers to sell at 4.40c., St. Louis, have not been without takers. The interest is to a considerable extent speculative, however, as galvanizers, brass mills, and rollers have not been receiving any sudden increase in orders. High-Grade remains in more than ample supply, probably being responsible for a large part of the stock of 101,744 tons that existed at the end of May.

Blende in Joplin has sold at $31, Prime Western, basis 60 per cent, and $30 for table and flotation concentrate.

Tin Below 30c.

Continued unfavorable statistics, indicating that production is still too large for the present consumptive demand, resulted in a further drop in prompt Straits to as low as 29½c. on the 17th, reacting to 29⅞c. yesterday. Buying has not been stimulated much, however. Forward tin has sold at premiums of about 15 points per month.

Silver Still Going Down

Financial, political, and economic conditions in the Far East continue to have an adverse effect on silver, and the price, after a rally above 36c. early in June, is again well below 35c. No constructive measures to arrest the decline have yet been taken, though the subject is being discussed. World production in March was 18,343,000 oz., compared with 16,653,000 in March, 1929, when the price was 56c.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 per cent plus grades, price of leading interest, 24.30c. Outside market, 99 per cent plus, 24.30c.; 98-99 per cent, 23.90c. London, 98 per cent, £95 per long ton, less 2 per cent for domestic consumption.

ANTIMONY—Per lb., duty paid: Chinese brands, spot, 7@7.10c.; futures, nominally 6.90@7c. Dull. Mexican offerings at 7¼c. Cookson's "C" grade, spot 12⅞c. "C.M.C." grade, spot, 10¾c. Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 10c. First quarter antimony production in Hunan, China, 4,100 long tons, compared with 4,200 tons in preceding quarter.

BISMUTH—Per lb., in ton lots, $1. Smaller lots $1.15 and up. London 4s.

CADMIUM—Per lb., 70c. London 3s. 8d. for prompt.

CHROMIUM—Per lb., 97@98 per cent grade, 95c.@$1.

COBALT — Per lb., f.o.b. Canadian works: Shot or rondelles, 97@98 per cent, $2.50. Contract sales booked at discounts, depending on quantity. Black oxide, 70 per cent, $2.10. London, nominal, 10s. for metal in small lots, 8s. for black oxide; 8s. 10d. for gray.

GERMANIUM DIOXIDE—Per gram in 200- to 300-gram lots, $3.50.

INDIUM—Per gram, $15.

IRIDIUM—Per oz., $250@$265 for 98 @99 per cent sponge and powder. London, £41 10s.

LITHIUM—Per lb., 98@99 per cent grade in 100-lb. lots, $18.

MAGNESIUM — Per lb., 12-lb. ingots (4x4x16 in.), 65c.@$1, depending on quantity; 2½- or 3-lb. sticks (1⅛ in.), 70c.@$1.05, depending on quantity. London, 2s. 10d.@3s. for 99 per cent ingots or sticks.

MOLYBDENUM—Per lb. in 50- to 100-lb. lots, 99 per cent, $11; 97 per cent, $9. (Usually sold as calcium molybdate or ferromolybdenum, which see.)

Daily Prices of Metals

June	Electrolytic Copper	Straits Tin	Lead		Zinc
	Refinery	New York	New York	St. Louis	St. Louis
5	12.775	30.625	5.50	5.40	4.65
6	12.60	30.875	5.50	5.40	4.60@4.65
7	12.60	30.875	5.50	5.40	4.625
9	12.60	30.875	5.50	5.40	4.60@4.65
10	12.60	30.375	5.50	5.40	4.575@4.60
11	12.525	29.875	5.50	5.40	4.525@4.575
Av'ge	12.617	30.583	5.500	5.400	4.610
12	12.025@12.275	30.00	5.50	5.40	4.50@4.55
13	11.775	29.75	5.50	5.40	4.50
14	11.725	29.625	5.50	5.40	4.50
16	11.775	29.50	5.50	5.40	4.475@4.50
17	11.55	29.50	5.40	5.30	4.40@4.425
18	11.35	29.875	5.40	5.30	4.40
Av'ge	11.721	29.708	5.467	5.367	4.471

Average prices for calendar week ended June 7, 1930, are: Copper 12.717c.; Straits tin, 30.588c.; New York lead, 5.500c.; St. Louis lead, 5.400c.; zinc, 4.638c.; and silver, 35.563c.

Average prices for calendar week ended June 14, 1930, are: Copper, 12.229c.; Straits tin, 30.083c.; New York lead, 5.500c.; St. Louis lead, 5.400c.; zinc, 4.548c.; and silver, 35.375c.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices are quoted on a delivered basis; that is, delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices of refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted.

Quotations for copper are for the ordinary forms or wirebars and ingot bars. For ingots an extra 0.05c. per pound is charged; for slabs, 0.075c.; and for cakes, 0.125c. up, depending on weight. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight differential. The contract price for High-Grade zinc delivered in the East is 1c. above the St. Louis price for Prime Western.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

Silver, Gold, and Sterling Exchange

June	Sterling Exchange "Checks"	Silver		Gold London	June	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
5	$4.85 9/16	36 1/8	16 3/4	84s11 1/2d	12	$4.85 9/16	35 1/8	16 3/16	85s00 1/4d
6	4.85 5/8	35 5/8	16 1/2	84s11 1/2d	13	4.85 5/8	34 7/8	16 3/16	84s11 1/2d
7	4.85 5/8	36 1/4	16 13/16	.....	14	4.85 9/16	34	15 7/8	.....
9	4.85 9/16	36 3/8	Holiday	Holiday	16	4.85 9/16	33 5/8	15 11/16	84s11 1/2d
10	4.85 9/16	36 5/8	16 7/8	84s11 1/2d	17	4.85 5/8	34 1/8	15 13/16	85s 0 d
11	4.85 1/2	35 1/4	16 7/16	85s00 3/8d	18	4.85 1/2	34	15 11/16	85s 0 d

Average of week ended June 11: Silver, 36.042c.; Sterling Exchange, $4.85573.
Average for week ended June 18: Silver, 34.292c.; Sterling Exchange, $4.85573.

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of silver, 999 fine. London silver quotations are in pence per troy ounce of bar silver, basis of 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command five-thirty-seconds cent premium.

London

June	Copper Standard		Electrolytic Spot	Tin		Lead		Zinc	
	Spot	3 M		Spot	3M	Spot	3M	Spot	3M
5	52 3/4	53	60 1/2	137 1/2	139 1/2	17 13/16	18 1/8	16 3/4	17 1/2
6	52 1/4	52 1/2	60 1/2	139	141 1/8	18 1/16	18 1/4	16 3/4	17 1/2
9					Holiday				
10	51 1/4	51 1/2	60 1/2	137 5/8	139 5/8	18	18 3/16	16 9/16	17 1/4
11	50 3/4	51 1/8	59	135 3/8	137 3/8	18	18 3/16	16 1/2	17 1/8
12	49 11/16	50	58	134 7/8	136 3/4	17 7/8	18	16 9/16	17 1/8
13	48 7/8	49 1/8	57	133 3/4	135 1/2	17 13/16	17 13/16	16 9/16	17 3/16
16	47 1/4	47 1/2	54	133 3/8	135 1/8	17 3/4	17 3/4	16 7/16	17 1/16
17	47 1/8	47 1/4	54	132 1/2	134 1/2	17 7/8	17 13/16	16 5/16	16 15/16
18	46 7/8	47 1/8	54	133 1/8	135	17 7/8	17 11/16	16 3/8	16 15/16

Prices for lead and zinc are the official prices for the morning session of the London Metal Exchange; prices for copper and tin are the official closing buyers' prices. All are in pounds sterling per long ton (2,240 lb.).

NICKEL—Per lb., ingot, 35c.; shot 36c.; electrolytic, 35c. (99.90 per cent), for single lots of spot metal. London, per long ton, £170@£175.

OSMIUM—Per oz., $70@$75; nominal. London, £14 5s.

PALLADIUM—Per oz., $25@$27; London, £4 10s.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $46. Transactions between dealers and refiners in the outside market are commonly reported at several dollars less. London, per oz., £8 10s.

QUICKSILVER—Per 76-lb. flask, $118 @$120. Trading less active, but prices are steady. London quiet, with offers at £22 12s. 6d.

RADIUM—Per mg. radium content, $70.

RHODIUM—Per oz., $50@$55. Nominal. London, £11.

RUTHENIUM — Per oz., $40@$45. Nominal. London, £9 10s.

SELENIUM—Per lb. in 500-lb. lots: Black, powdered, amorphous, 99.5 per cent pure, $2. London, 7s. 8d.

TANTALUM—Per kilo: Heavy sheet, chemically pure, $128; bars, $145; tantalum powder, c.p., $69.35.

TELLURIUM—Per oz., 15@18c.

THALLIUM METAL—$12.50@$15 per pound.

TITANIUM—Per lb., 80@90 per cent grade, $5.

TUNGSTEN POWDER—Containing 98 per cent tungsten, per lb., $1.75.

Metallic Ores

ANTIMONY ORE—Bolivian ore, 60 per cent metallic antimony, $1.15 per short ton unit, c.i.f. New York.

BERYLLIUM ORE—Beryl, f.o.b. mines, $5@$6 per unit of BeO, minimum 10 per cent BeO.

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, Indian and Rhodesian ores, $20 for 46@47 per cent Cr_2O_3 ore. and $24 for 50@51 per cent ore.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores:

Mesabi, non-bessemer, 51½ per cent iron, $4.50. Old Range, non-bessemer, $4.65.

Mesabi, bessemer, 51½ per cent iron, $4.65. Old Range, bessemer, 51½ per cent, $4.80.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 56 to 63 per cent, 10c.

Foreign ores, alongside docks Atlantic ports, cargo lots, cents per unit:

North African and Swedish, low-phosphorus, 10½@11c.

Spanish and North African basic, 55@60 per cent, 9½@10c.

Swedish foundry or basic, 66@68 per cent, 10c.

Newfoundland foundry, 55 per cent, 9c. Nominal.

MANGANESE ORE—Per long-ton unit of Mn, c.i.f. North Atlantic ports, cargol ots, exclusive of duty: Brazilian, 46@48 per cent Mn, 28c.; Indian, 48@50 per cent, 30c. Caucasian, 52@55 per cent, 30c.; Cuban, minimum 47 per cent, 32c.

Per ton in carload lots:

Chemical grades, powdered, coarse or fine, minimum 80 per cent MnO_2, Brazilian or Cuban, $60. Javan or Caucasian, 85 per cent minimum, $65. Domestic, 70 to 72 per cent, $40@$50, f.o.b. mines.

MOLYBDENITE—Nominally 32s. 6d.@35s. per long ton unit in London.

TANTALUM ORE—Per unit of Ta_2O_5, basis 60 per cent ore, $13, nominal.

TITANIUM ORE—Ilmenite, per gross ton, 45@52 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$12, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., guaranteed minimum 94 per cent concentrate, 10c. in carload lots.

TUNGSTEN ORE—Per short ton unit of WO_3, N. Y.: Wolframite, $11.50@$12.50 for spot. Market dull. Domestic scheelite, $13@$14. Exports of tungsten ore from South China to the United States in first quarter, 1930, were 1,861,-364 lb., valued at $482,087, compared with 2,308,215 lb., valued at $409,718, for full year 1929.

VANADIUM ORE—Per lb. V_2O_5 contained, 28c.

ZIRCON ORE—Per net ton containing 55 per cent ZrO_2, f.o.b. Atlantic seaboard, $40@$45 in 30-ton lots.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE — Per ton, f.o.b. mines, 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading sellers for delivery on contract:

Crude No. 1, $475@$575; crude No. 2, $325@$375; spinning fibers, $150@$175; magnesia and compressed sheet fibers, $100@$135; shingle stock, $50@$85, various grades; paper stock, $35@$40; cement stock, $15@$25; short fibers, $10@$15; floats, $12@$15.

Per ton c.i.f. New York: Rhodesian crude No. 1, $400; No. 2, $325.

BARIUM CARBONATE (Witherite)—Per ton: 90 per cent, 200 mesh, $47; 100 mesh, $44.

BARYTES—Per ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude (per long ton), $6.50@$7. Washed and water floated to 97 per cent through 325 mesh, $18.

Missouri: Water ground and floated, bleached, $23, car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $7.75, f.o.b. mines.

BAUXITE—Per long ton: Domestic ore, chemical, crushed and dried, 55 to 58 per cent Al_2O_3, 1.5 to 2.5 per cent Fe_2O_3, $7.25@$8.25, f.o.b. *Alabama* and *Arkansas* mines. Other grades, 56 to 59 per cent Al_2O_3, 5 to 8 per cent SiO_2, $6.75@$8.25, f.o.b. *Arkansas* mines. Pulverized and dried, $12@$13, f.o.b. *Arkansas* mines; calcined, 78 to 84 per cent Al_2O_3, $18@$19, f.o.b. *Arkansas* mines.

Per metric ton, foreign, c.i.f. Atlantic port: Dalmatian, 50 to 55 per cent Al_2O_3, 1 to 3 per cent SiO_2, $4.50@$6.50; Istrian, 54 to 57 per cent Al_2O_3, 3 to 5 per cent SiO_2, $5.50@$7; French, 56 to 59 per cent Al_2O_3, 2 to 5 per cent SiO_2, $6@$8.

BORAX—Per lb.: Carload lots, in bags, crystals, 2¼c.; granulated or powdered, 2½c.; f.o.b. shipping point.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* and *South Carolina* mines, crude lump, No. 1, $6; crude No. 2, $5; washed, $8; powdered and air-floated, $8@$12; ground, $7@$15.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour in 100-lb. bags (bags extra), No. 1, $20; No. 2, $17.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots.

Imported English, f.o.b. American ports; lump, $14@$20; powdered, $40@$45.

DIATOMITE—Per short ton, f.o.b. producing plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $25; natural aggregate, ¼ in., $18@$20; air-floated powder, $45; 80 to 85 per cent silica, 98 per cent through 200 mesh, $20 in carload lots.

EMERY—F.o.b. *Pennsylvania* and *New York*, in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 6½c.; domestic, 3½c.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton, No. 1 pottery grade, crude, $6.50@$8; No. 2, glass grades, $5.50@$6.

No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 20 mesh, $10.25@$12; 140 mesh, $13.50@$16; 200 mesh, $15@$18; all per short ton.

New Hampshire, per ton: Pottery grade, $8. Best quality lump, $8.50.

New York, per ton, f.o.b. cars: No. 1 crude, $9. Soda feldspar, 140 mesh, first grade, $16 per short ton; 200 mesh, first grade, $18.

Maine, per ton: Best pottery grade, ground, $19.

FLUORSPAR — Per ton: F.o.b. *Kentucky* and *Illinois* mines:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $28 in car lots.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16; 94 lump, $21; ground, 97, $35.

Foreign spar, duty paid, $17, tidewater.

FULLER'S EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 16 to 60 mesh, $17; 60 to 90 mesh, $14; 100 mesh up, $7.

Powdered, import duty paid, $24@$26 per ton.

GARNET — Per ton: domestic, f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry:

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $25.50.

GRAPHITE—Per lb., f.o.b. *New York:*

Ceylon lump, 8@9c.; chip, 6½@7½c.; dust, 3@5c.; Madagascar flake, 6½@8½c.

No. 1 flake, 8@16c.; fine ground, 3@14c. Ordinary fine ground, 3@5c.; high grade, 8@12c.; amorphous, 3@7c.

Crude amorphous graphite, $15@$35 per ton, according to grade.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade, in carload lots, $20.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $1.50@$5; ground, $4@$9; agricultural, $4@$8; calcined, $4@$13.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 3@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 50c.@$3.

Agricultural, 75c. up to $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Calcined, 80 per cent through 200 mesh, $40@$43; dead-burned, $29; crude, $11. *Washington:*

[1]Price furnished by Foote Mineral Company, Philadelphia.

Dead-burned magnesite, $22 per ton, Chewelah, Wash.

MICA—Per ton, f.o.b. plant:

New Hampshire: Mine-run sheet and punch, $320@$340; clean shop scrap, $20@$25; roofing, $21.50@$25. White dry ground, 20 mesh, $25; 40 mesh, $35; 60 mesh, white, $39; 100 mesh, $45; 200 mesh, $60. Granite mica facings for cement block and stucco use, $8@$12, depending on size between ¼ in. and 60 mesh. Disks, 1¼ in. No. 1, per lb., $1.25; 2½x2 in. square cuts, $3.25.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, per lb., f.o.b. *New York,* duty paid: No. A1, $2.50; No. 1, $2; No. 2, $1.65; No. 3, $1.15; No. 4, 60c.; No. 5, 45c.

MONAZITE—Per ton (minimum 6 per cent ThO_2): $60.

OCHER — F.o.b. *Georgia* mines, per ton: $19@$20 in sacks; $21@$22 in barrels; washed and water floated, $18; second grade, 99 per cent through 225 mesh, $18.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7.15; 75 per cent, $6.40; 74@75 per cent, $6.15; 70 per cent, $4.65; 68 per cent, $4.10.

Florida, pebble, domestic: 76@77 per cent, $6.50; 74@75 per cent, $5.50; 72 per cent, $4.50; 70 per cent, $4. Dull.

Tennessee, ground, 80 per cent through 300 mesh, 33 per cent P_2O_5, $11.80 per short ton.

POTASH—The ruling contract prices (short tons) are as follows:

	Bags	Bulk
Muriate of potash, 80@85 per cent, basis 80 per cent	$37.15	$35.55
Sulphate of potash, 90@95 per cent, basis 90 per cent	48.25	46.65
Sulphate of potash-magnesia, 48@53 per cent, basis 43 per cent	27.80	26.20
Manure salt, 30 per cent	22.15	19.15
Manure salt, 20 per cent	15.65	12.65
Kainit, 14 per cent	12.70	9.70

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur; c.i.f. United States ports; guaranteed 48 per cent sulphur: Spanish, 13c.; Tharsis, furnace size, 2½ in. diameter, 14c. Cinder from ore to remain property of buyers.

QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear but flawed, pieces ¼ to ½ lb. in weight, 20c. Flawless, for optical purposes, four times above price; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois: 325 mesh, $18@$40 for 92 to 99½ per cent grades. Market steady. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35 @$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content.

SULPHUR—Per long ton for domestic market, $18 f.o.b. Texas mines; $22 for export, Atlantic ports.

TALC—Per ton, carload lots. f.o.b. works, containers included unless otherwise specified:

Vermont: 99 per cent through 200 mesh, extra white, bulk basis, $8@$8.50; 97 to 98 per cent through 200 mesh, medium white, $7.50@$8.

New York: Double air-floated, short fiber, 200 mesh, $13.75; 325 mesh, $14.75.

Georgia: Powdered, gray, $7.50@ $10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9.

New Jersey: Soapstone, ground, $10 @$12.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh, rose and cream colored, $16. Double ground through 110 mesh, rose and cream, $18. Air-floated through 200 mesh, rose and cream, $27.50; mill run. $16. Demand quiet.

Rolled Metals

COPPER — Sheets, hot-rolled, per lb., 22¼c.; wire, per lb., f.o.b. mill, 13¾c.

LEAD SHEETS—Full rolled, 8¼c. per lb.; clipped, 8½c.

MONEL METAL—Per lb., sheets, full finished, 42c.; rods, hot-rolled, 35c.

NICKEL—Per lb., sheets, full finished, 52c.; rods, hot-rolled, 45c.

ZINC SHEETS—Per lb., 10c., f.o.b. works. Strip, 9½c.

Alloys

FERROCERIUM—Per lb., $6 in 100-lb lots.

FERROCHROME—Per lb. of contained chromium, 4 to 6 per cent carbon, 11c. on requirement contracts; spot shipments, 11½c. Maximum 2 per cent carbon, 17½c., contracts. Freight allowed on carload lots east of Mississippi River and north of Baltimore.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $94@$99. Spiegeleisen, 19@21 per cent, $34 on carload business, f.o.b. furnace.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.15.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50, f.o.b. *Alabama* and *Tennessee.*

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River and north of Baltimore: 50 per cent, $83.50; 75 per cent, $130; 14@16 per cent, $39, f.o.b. Suspension Bridge, N. Y. Quotations for spot shipments $5@$10 per ton higher on 50 and 75 per cent grades.

FERROCARBONTITANIUM — Per ton: $160, f.o.b. producer's plant.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, $1.35@$1.45 f.o.b. works.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, freight allowed east of Mississippi, $3.15@$3.50, depending on grade and quantity.

MUNTZ METAL—Rods, 18¼ c.; plates, 21c.

NICKEL SILVER — Sheets, per lb., 10 per cent, 26¼@26¾c.; 18 per cent, 29½@ 30c. Rods and wire, 10 per cent, 29¾c.; 15 per cent, 33½c.; 18 per cent, 37c. Effective June 13.

PHOSPHOR BRONZE—Sheets and rods, 5 per cent tin, 33¼c. Wire, 5 per cent, 33¾c.; 10 per cent, 39¾c. Effective June 13.

Metallic Compounds

ANTIMONY OXIDE—White, Chinese, 99 per cent Sb_2O_3, 9¾@10¼c. per lb. Nominal.

ARSENIOUS OXIDE (White arsenic)—Per lb., 4c., delivered, all positions. Fair demand from insecticide trade and prices are steady. London, per long ton, £15¾@£16 for Cornish white.

CALCIUM MOLYBDATE OR MOLYTE—Per lb. of contained Mo, 95c.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 4¾c. for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude natural, in bags ex vessel, Atlantic ports, $2.05@$2.10 for June deliveries.

SODIUM SULPHATE (Salt Cake)—Per 100-lb. bags, f.o.b. works, $1; in barrels, $1.10.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6¼c.; French red seal, in bags, 9⅜c.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43@$46, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35 @$38.

MAGNESITE—Brick, per net ton, f.o.b. works: 9-in. straights, $65, f.o.b. plant. Cement, $40, seaboard.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio,* $43; *Alabama,* $51; *Illinois,* $52.

ZIRKITE—Per lb.: Powdered, 65@70 per cent ZrO_2, 3½c. Brick, straights, 80c.@$1 each.

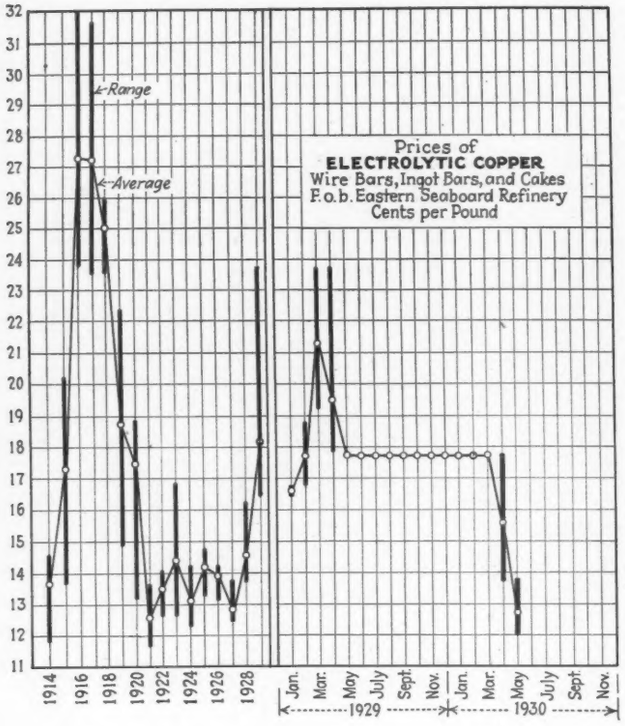
Iron, Steel, and Coke

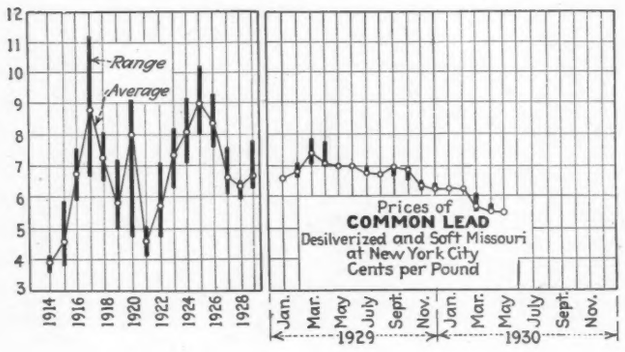
IRON—Per gross ton, Valley furnaces: Bessemer, $19; basic, $18.50; No. 2 foundry, $18.50.

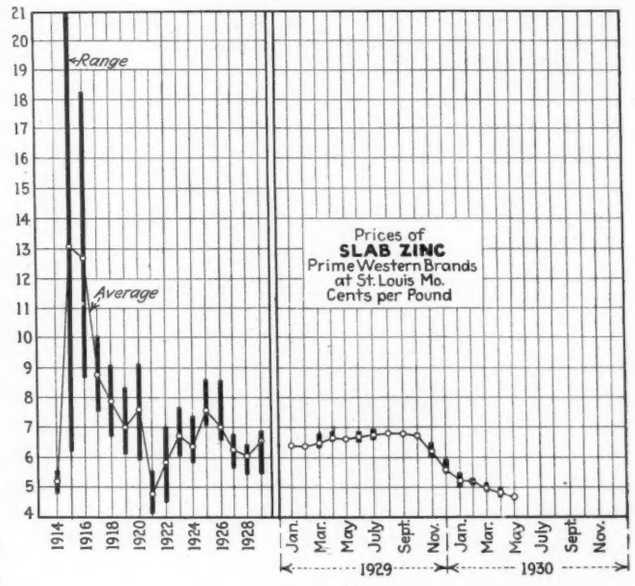
STEEL—Base prices per gross ton, Pittsburgh, billets and slabs, $31@$32; plates, structural shapes, and soft steel bars, per 100 lb., $1.75.

COKE—Per gross ton, Connellsville furnace, $2.50. Connellsville foundry, $3.50@$4.85. Byproduct coke, Ohio and Kentucky (Connellsville basis), $6.50; Buffalo and Detroit, $8.50.

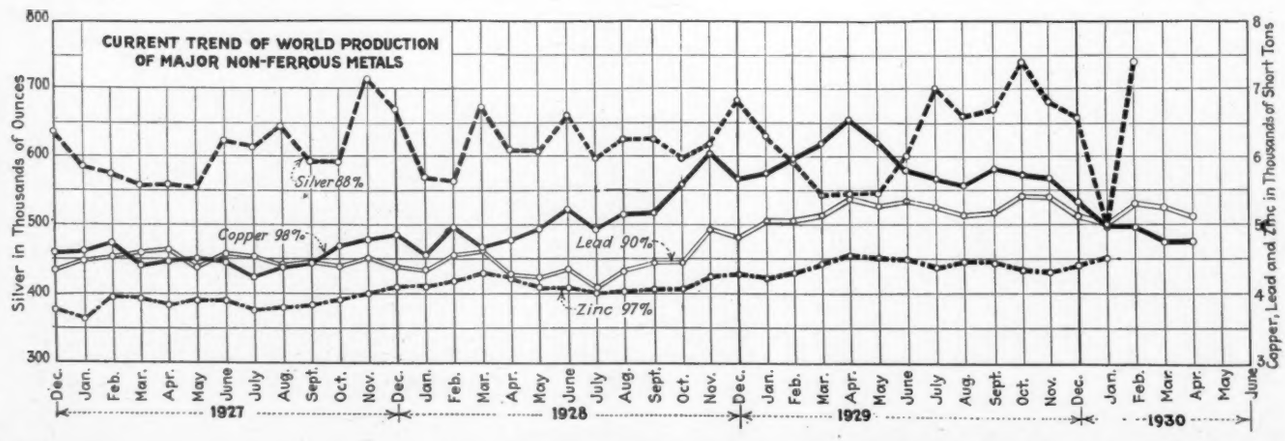
Metal Price Curves



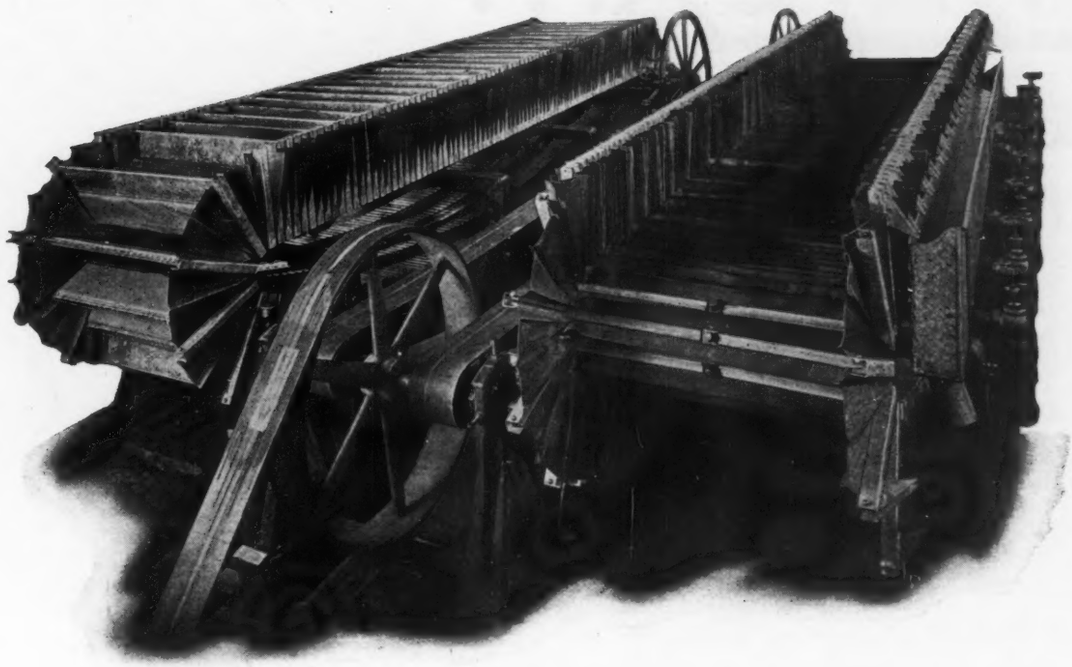




THE CURVES below are not to be considered as permanent records of production. They show merely the current trend in terms of daily output according to the latest estimates of the American Bureau of Metal Statistics. The figures represent production from countries that produce approximately 98 per cent of the world's copper, 97 per cent of the zinc, 90 per cent of the lead, and 88 per cent of the silver. The zinc curve has not been plotted for the past months of 1930, owing to the absence of some European production statistics; this situation is believed to be only temporary in character. Delay in receipt of statistics from Mexico accounts for the failure of the silver curve to be up to date.


CURRENT TREND OF WORLD PRODUCTION
OF MAJOR NON-FERROUS METALS
Silver in Thousands of Ounces
Copper, Lead and Zinc in Thousands of Short Tons
Silver 88%
Copper 98%
Lead 90%
Zinc 97%
Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June
1927
1928
1929
1930

Top Feed Widens Application



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LINATEX...

as skip linings saves a South African mine $280,000

RANDFONTEIN ESTATES GOLD MINING COMPANY
Witwatersrand, Limited

Mine Office
Randfontein, 16th April, 1930
Transvaal.

J. W. Kirkland & Son Pty. Ltd.
Beresford House
Main Street, Johannesburg

Dear Sir,

Rubber Lining for Skips.

Enclosed please find, all available data to date re the above.

The present actual shaft running time for the two South Vertical skips to date, are 65 and 99 days respectively. They have a further estimated life of at least another 90 days. During the month of February the rubber lined skips were in commission for the greater portion of the month: and the skip factor rose, from 5.4 tons to 5.8 tons. Assuming 30 trips per hour, 16 hours per day, and 26 days per month, and basing increased tonnage hoisted on calculated increase only: viz. .25 tons per trip, then the increased tonnage hoisted per month is approx. 3000 tons, and (at 5 dwt. value or $4.85 per ton) per month—$14,550. If the increase of skip factor is entirely due to rubber lined skips, then the increased value hoisted per month will be approx. $23,765. The annual increase of tonnage value would be approx. $174,600. In the second case the annual increase of tonnage value, gain is $280,000. This does not include saving of shaft work, due to less spillage. The last skip was in commission for fourteen consecutive days, and during that period did not need, and was not in any way cleaned, and was clean when taken out of the shaft.

Yours faithfully
(Signed) W. H. MITCHELL, Chief Engineer

Above is a copy of a letter received from Randfontein Estates Gold Mining Co.

This mine is now lining all skips with LINATEX.

A LINED SKIP

Linatex can cut your costs——

In preventing abrasion and corrosion; as pipe-linings and chute liners, etc.

This is one use where Linatex has proved valuable in dealing with peculiar conditions.

In preventing abrasion and corrosion Linatex is being equally valuable to many mines all over the world.

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You pay these men for a full day's work—but they can't deliver full value if compelled to lose time waiting for smoke to clear away after blasts; or to work in an atmosphere that lacks normal oxygen content.

An old story to mining executives; but now being corrected in well managed mines the World over by secondary ventilation with du Pont Ventube; which carries good air from the main air currents, to even the most remote working places, efficiently and at low cost.

Light, strong and flexible, du Pont Ventube is providing money-saving ventilation in practically every important mining center in the World. Write today for complete information.

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VENTUBE

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To Install Oliver United Filters

EAST GEDULD MINES, LTD., recently selected Oliver United Filters for its new cyanide plant in the Far East Rand. Seven 14′ x 16′ cyanide units are to be installed.

Such a company, located where it is, could not do otherwise than pin its faith on the filters proved out by long experience and recommended by engineers who know metallurgical filtration forward and backward.

East Geduld's selection of Oliver United Filters carries a pointed suggestion to other mill officials.

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Factories:
Oakland, Calif., Hazleton, Penn., Peterboro, England
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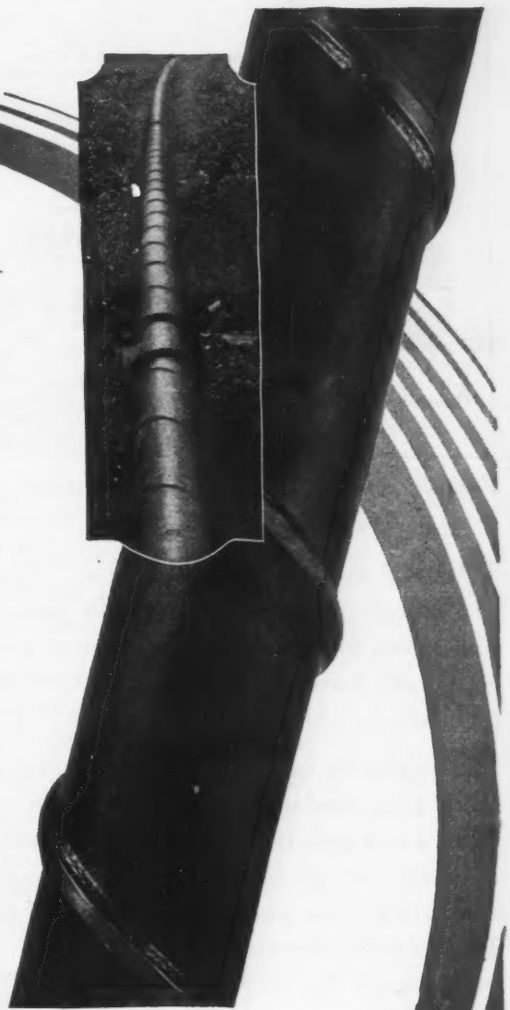
Why Mining Men *prefer* NAYLOR *SPIRALWELD* PIPE



NAYLOR *Spiralweld* Pipe is universally applicable to every mining requirement due to these five outstanding advantages---

Maximum Structural Strength (It's a pressure pipe carrying the same pressures as standard weight wrought pipe.)

Minimum Weight (One half the weight of standard weight wrought pipe, it reduces transportation, handling and laying costs.)

Positive Water-tightness (Assured by its *spiral-welded* lock-seam-truss.)

Superior Corrosion Resistance (It is made of Toncan Iron---an alloy which has a greater resistance to rust and corrosion.)

Lowest Frictional Losses (Its perfect roundness and smooth interior reduce frictional losses to a minimum.)

Before you select pipe for your next requirements, it will be to your decided advantage to first consider the outstanding advantages of Naylor *Spiralweld* Pipe.

NAYLOR PIPE COMPANY

Main Office and Plant, 1230 East 92nd Street, CHICAGO

Sales Offices:

3116 Chrysler Building, New York — Witherspoon Building, Philadelphia,
507 Philtower Building, Tulsa — 601 Post-Dispatch Building, Houston

MONTREAL, CAN., Mechanical Equipment Co., 660 St. Catherine St., West

TONCAN COPPER

Naylor Pipe

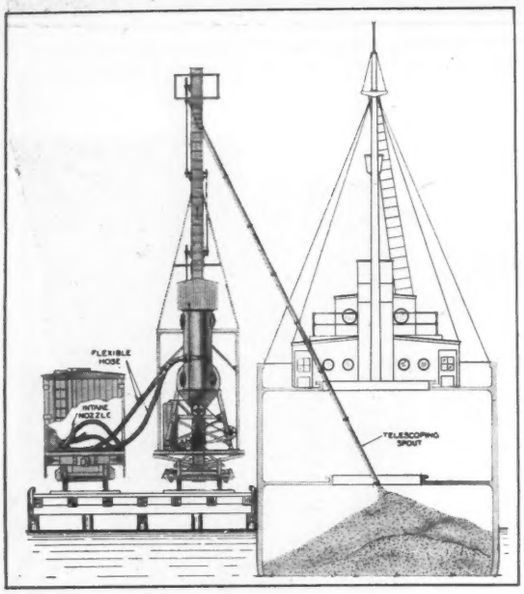
Maximum Structural Strength — Mo-lyb-den-um — With Minimum Weight

IRON

Standardized Naylor Pipe is made in sizes 6" to 12" I. D. and 14" to 20" O. D. in any uniform length desired up to 40' 0". Ends made to wrought pipe standards for all types of coupling.

Where corrosion is not a problem, Naylor Pipe can be furnished in steel.

Toncan Copper Molybdenum Iron possesses a superior corrosion resistance, making it the favored pipe material.



Portable conveyor on dock unloading potash from car to ship

"Labor Has Been Cut in Half"

Thru DRACCO Pneumatic Conveyors

at the U. S. Industrial Chemical Co.

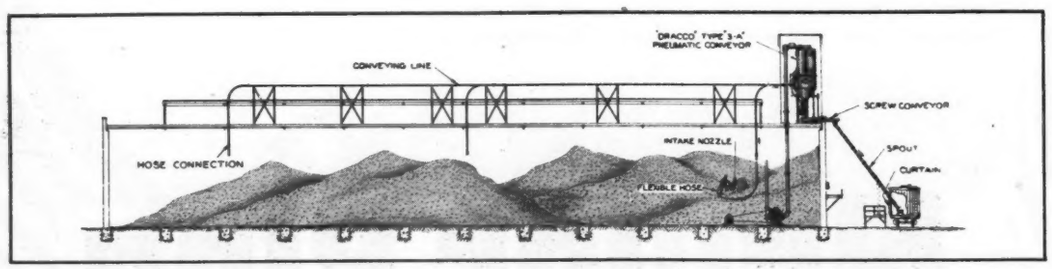
EIGHT men instead of eighteen are now required to convey vegetable potash from warehouse to ship, since two Dracco pneumatic conveyors have replaced mechanical handling methods.

One conveyor, shown below, picks up the material from storage, and delivers it to boxcars. After a two mile transshipment, a second Dracco conveyor, of special design, unloads the cars, and delivers the potash to the hold of the ship. The complete description is reprinted in Bulletin No. 519, which is now available.

The U. S. Industrial Chemical Company states in closing, "The pneumatic equipment has been in operation over two years, and has shown that it is dependable and durable. The power consumption is higher, but the labor involved has been cut in half; the material loss in spillage and dust eliminated; working conditions have been greatly improved; and a more convenient conveying system has been developed for this service."

DRACCO

Substituting Dracco pneumatic handling for your present method may show you new sources of saving. Dracco engineers will gladly and without obligation discuss your problem with you.



Stationary conveyor at warehouse to convey potash from storage to cars

THE DUST RECOVERING & CONVEYING CO.

Engineers and Manufacturers **CLEVELAND, OHIO**

Air Filter for Treatment of *Pollenair* TRADE MARK **Hay Fever and Pollen Asthma**

DORRCO

There is no substitute for EXPERIENCE!

When Benjamin Franklin said that "The wise man profits by the experience of others" he summed up exactly the attitude of the wise purchasers of industrial equipment today. These men know that it is cheaper to buy experience than to try experiments. They know that there should be more to a machine than meets the eye and that often the invisible, intangible parts are the ones that really count.

These unseen and unweighable parts are the knowledge and experience of the equipment manufacturer. They are the parts that give an added value to the iron and steel in the equipment. They are the parts that mean results—something much more valuable to the purchaser than a mere machine.

And these are parts that can't be copied. For while machines may be imitated, methods followed, there is no substitute for experience.

Behind all Dorr equipment is an unequalled fund of knowledge, built on a long and varied experience with all types of wet-material handling operations

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ENGINEERS

247 PARK AVENUE NEW YORK CITY

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A Complete Encyclopedia on the Production, Fabrication and Uses of Aluminum. *Just Out!*

Here, in one comprehensive and coordinated work, is all the information required by research workers and manufacturers concerned with the increased and more effective adaptation of aluminum to industrial purposes. 28 experts cover the whole subject—thoroughly and authoritatively—describing the methods of its production, fabrication and application to industrial purposes.

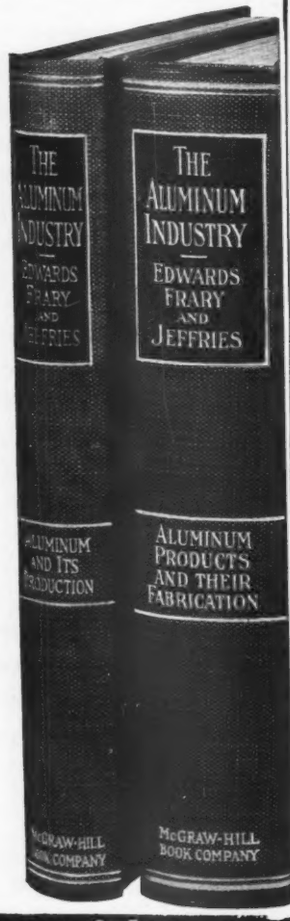
The Aluminum Industry

by Junius David Edwards
Assistant Director of Research, Aluminum Company of America
and Francis C. Frary
Director of Research, Aluminum Company of America
and Zay Jeffries
Consulting Metallurgist, Aluminum Company of America

2 volumes, 1228 pages, 6x9, not sold separately, Price $12.00

This work combines the features of an interesting treatise of this growing industry, and an all-embracing reference work of the latest data needed by the aluminum technologist, the metallurgist, the engineer and the manufacturer.

Its first volume covers the development of the aluminum industry and all the details of the mining and refining of the ores of aluminum. The second volume describes the properties of aluminum and its alloys and the methods employed in the working and fabrication. A detailed analysis of the engineering considerations involved in the many uses and applications of aluminum is followed by a series of chapters devoted to the uses of aluminum in the various industries.



Chapter Headings

Volume I.

1. The Story of Aluminum
2. The Story of the Hall Process
3. The Aluminum Industry in Europe
4. Ores of Aluminum
5. The Production of Alumina
6. Acid Processes for the Extraction of Alumina
7. Electrothermal and Miscellaneous Furnace Processes for the Production of Alumina
8. Materials for the Reduction Process—Electrolyte and Carbon Electrodes
9. The Production of Aluminum

Volume II.

1. Commercial History of Aluminum
2. Physical and Chemical Properties of Aluminum
3. Constitution and Structure of Aluminum Alloy Systems
4. Properties of Aluminum Alloys
5. Commercial Alloys of Aluminum
6. Melting Aluminum
7. Casting of Aluminum and Its Alloys
8. Working of Aluminum
9. The Relation of Cold Working to the Physical Properties of Aluminum
10. Heat Treatment of Aluminum Alloys
11. Joining Processes
12. Coating and Finishing of Aluminum
13. Aluminum Products and Their Uses
14. General Considerations on Use of Aluminum
15. The Design of Aluminum Structures
16. Aluminum in Transportation
17. Electrical Conductors of Aluminum
18. Aluminum in the Electrical Industry
19. Aluminum in the Home and in the Food Industries
20. Aluminum in the Chemical Industries
21. Some Metallurgical and Other Uses of Aluminum
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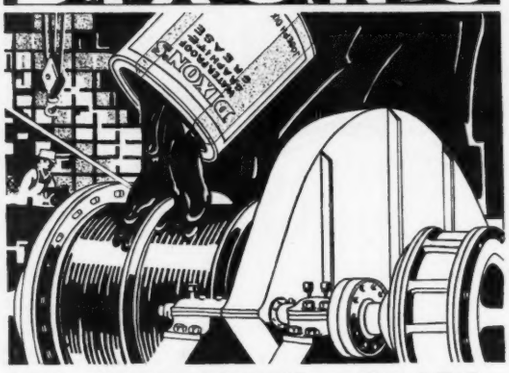

FOR WIRE ROPES, GEARS, CHAINS, PUMP PLUNGERS ETC.

DOUBLY SURE LUBRICATION . . . IN HARD MINE SERVICE

POOR lubrication ruins wire rope. For this service DIXON offers the mining industry Waterproof Graphite Grease.

In this DIXON Product, the highest grade mineral stock is combined with DIXON'S Flake Graphite, offering protection against both wear and corrosion. Of high lubricating value, impervious to water, alkali or acid, this grease penetrates to the innermost strands of the rope and minimizes internal friction.

Flake Graphite, in itself a lubricant, takes the wear that would otherwise come to the metals in contact. It cannot be washed off or thrown off.

Let a trial order convince you of the effectiveness of DIXON'S Waterproof Graphite Grease.

OTHER DIXON PRODUCTS

Graphite Cup Grease — Pipe Joint Compound
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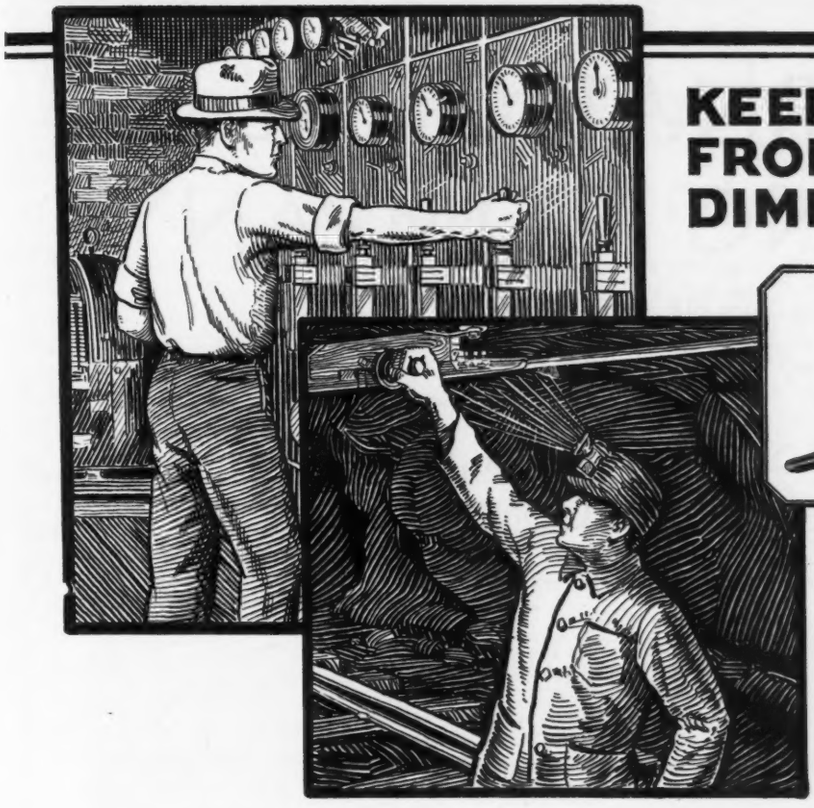
Joseph Dixon Crucible Co.

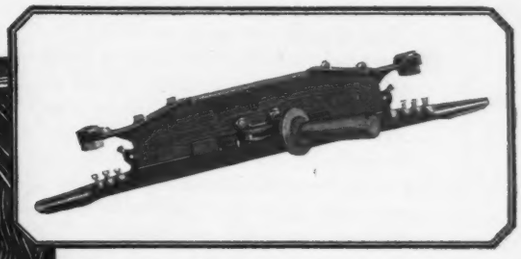
Established 1827

Jersey City — D X N TRADE MARK — New Jersey

DIXON'S WATERPROOF GRAPHITE GREASE



KEEPING DOLLARS FROM WAITING ON DIMES--



Type M Section Insulator Switches

Every care in manufacture is taken by O-B in making this important cost-cutting device. The best hickory, bronze of unusual strength, small tolerance limits, and good castings make O-B Switches the best switches to buy. Turn to pages 560-566, O-B Cat. No. 20.

Two Ways of "Killing the Line"

—but only one keeps the profits alive

MUST you disconnect power back at the sub-station or entry—interrupting all haulage—while adjusting trouble in a trolley circuit? If so, here again is "a dollar waiting on a dime."

Safety First! Kill the line by all means; but do it in such a way that you still keep the profits alive. With a few O-B Section Insulator Switches placed in the trolley circuit at strategic branch points, you can disconnect any section where repairs or extensions are to be made and still keep the rest of the haulageway producing profits. And the finer the degree in which the trolley is sectionalized, the greater the returns in profitable production.

If mine electricians want to save some of the countless steps they take each day in their work—if they and the management are interested in "keeping dollars from waiting on dimes"—here is an opportunity.

Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Co., Limited
Niagara Falls, Canada
1226M

Ohio Brass Co.

NEW YORK PITTSBURGH CHICAGO CLEVELAND ST. LOUIS ATLANTA DALLAS
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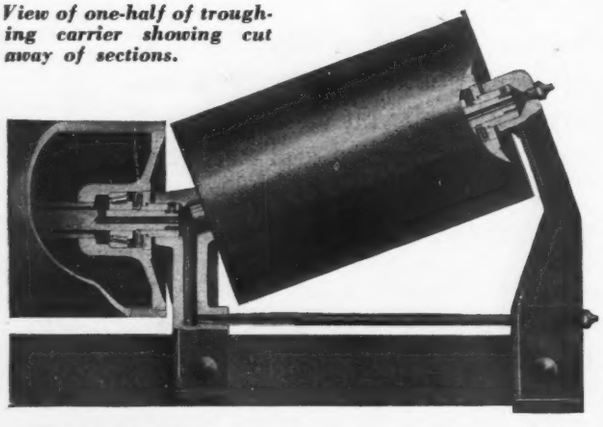
Refineries: Raritan Copper Works, Perth Amboy, N. J., and International Lead Refining Company, East Chicago, Ind.

DEPENDABLE, EVERY DAY SERVICE
WITH FAIRFIELD LIFE-TIME IDLERS!

View of one-half of troughing carrier showing cut away of sections.



Timken Roller Bearings reduce power consumption, save belt wear, and cut replacement expense. All rollers interchangeable. Built for belts from 16″ to 60″ in width and furnished with heavy angle bases for new or present stringer spacing.

WRITE FOR BULLETIN 105-EM.

THE FAIRFIELD ENGINEERING COMPANY
MARION, OHIO

FAIRFIELD
ELEVATING *and* CONVEYING MACHINERY

Tensile Strength is not the whole story!

AMSCO Manganese Steel possesses a distinctive toughness, in addition to a high tensile strength, that withstands the most severe shocks and stresses. Supplementing the peculiar self-hardening quality of the wearing surface, this toughness resists wear more satisfactorily than does any other commercially available alloy cast steel.

This statement is based upon more than 2000 tests with 150 alloy steels, subjected to as many as 30 different heat treatments in the AMSCO Research Department.

The average tensile strength of AMSCO Manganese Steel test bars is 125,000 pounds per square inch. This value, combined with an elongation of around 45%, gives a Work Factor immensely greater than that of competing steels when the latter are made and heat-treated to show the same tensile strength. This Work Factor, plus the developed hardness of the working face of an AMSCO casting in service explains the superior shock and abrasion resistance found in AMSCO Manganese Steel and justifies the thousands of users who use this steel for equipment parts subjected to grinding wear, severe shocks and heavy service stresses.

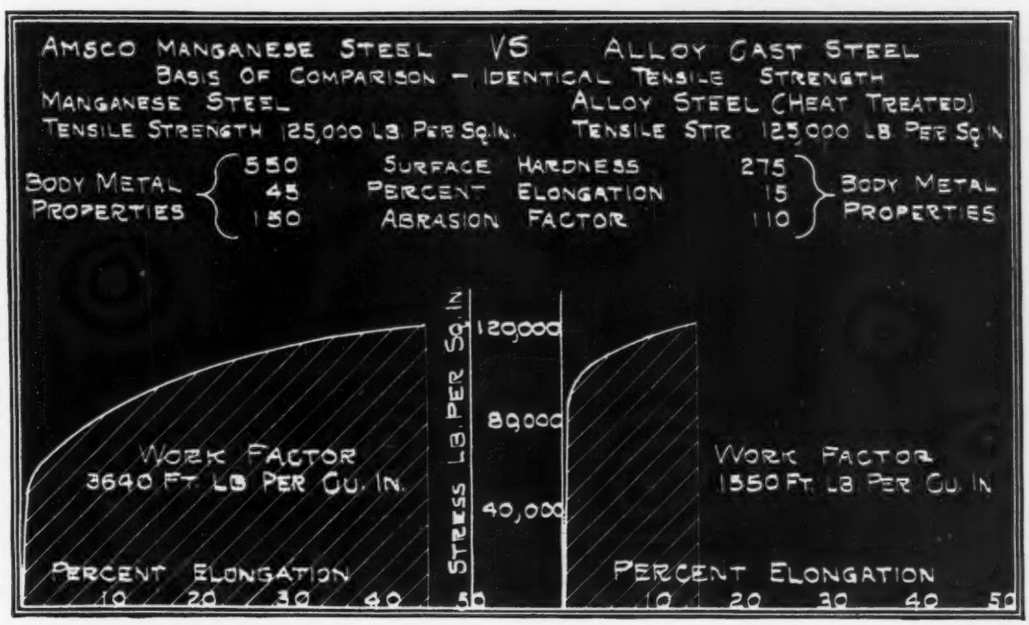


Table No: 2

Read These Authentic Facts!

The only fair way to compare various steels on the basis of tensile strength is to choose an identical value for this property. Any typical value might be chosen, but since Manganese Steel is so frequently the standard of comparison employed by competitive steels, the average tensile strength of the AMSCO Manganese Steel used in these tests is taken, namely 125,000 pounds.

Any of the special alloy steels containing nickel, chromium, manganese, molybdenum, or some combination of these, when heat-treated to show 125,000 lbs. tensile strength, will have an average surface Brinell of around 275 and an elongation usually lower than 15%. In typical service AMSCO Manganese Steel attains a surface hardness of 550 Brinell, without lessening the elongation of the body metal. The Fahrenwald abrasion factor of Manganese Steel is 150 and that of alloy steels under the above conditions is only 110. The higher the abrasion factor, the more wear-resistant is the steel.

The stress-strain diagrams above in Table No. 2 show the number of foot-pounds of energy consumed in rupturing competing cast alloy steels to be less than half that for AMSCO Manganese Steel on the basis of an identical tensile strength. Such steels have only ½ the Brinell hardness on the working face, and a considerably higher abrasion loss under identical conditions.

AMERICAN MANGANESE STEEL COMPANY, 376 EAST 14th STREET, CHICAGO HEIGHTS, ILLINOIS

Foundries and Sales Offices at Chicago Heights, Illinois—Burnside, Chicago, Illinois—New Castle, Delaware—Oakland, California — Los Angeles, California — Denver, Colorado — St. Louis, Missouri. FAHRALLOY General Sales Office at St. Louis, Missouri.

AMSCO

Sales Offices at New York City—Boston —Easton, Pa.—Lakeland, Fla.—Pittsburgh—Cleveland — St. Paul — Lynchburg, Va.— Portland, Ore. — Seattle — Vancouver — Winnipeg—Houghton, Mich.—Birmingham —New Orleans — Tulsa — Pittsburg, Kans. — Salt Lake City.

Keep that bottle neck in operation

THE shaft is the "bottle neck" of a mine. If for any reason the shaft ceases operating it can hold up work throughout the mine. This situation throws the responsibility of unfailing operation on the shaft hoisting engine.

Lubrication is an important factor in the efficient operation of a steam mine hoist engine . . . and effective lubrication here is often a knotty problem to solve. Long steam lines, wet steam and intermittent operation are three conditions difficult to contend with in order to obtain proper lubrication service.

Not all cylinder oils will lubricate effectively under wet steam or intermittent operation. Neither will all bearing oils perform equally well under the different conditions encountered in different mines. Due to the variety of steam conditions encountered it is dangerous to make any general recommendations for the lubrication of steam mine hoist engines. It is dangerous to make general lubrication recommendations for **any** mine equipment.

Because of this important fact, the Standard Oil Company (Indiana) offers the service of its staff of lubrication engineers in helping you obtain the best possible lubrication service. These men have studied mine lubrication and they have a complete line of the highest grade lubricants for mine service to work with.

Why not take advantage of this free service and call in one of these men?

STANDARD OIL COMPANY (*Indiana*)

General Offices: 910 South Michigan Ave. Chicago, Illinois

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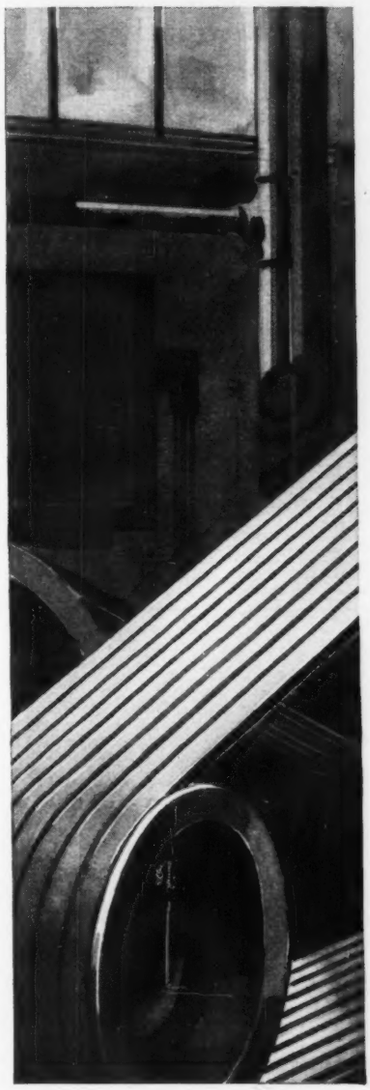
STANDARD OIL COMPANY (INDIANA) SERVICE

LUBRICANTS FOR ALL INDUSTRY

POWERFUL

DEPENDABLE · · DURABLE

SILENT · · COMPACT · · CLEAN



THE "D-V" Drive transmits power with minimum loss. There is no slippage and speed ratios are constantly maintained. Every essential feature necessary to insure dependable, economical power transmission is found in this drive. It is a Dodge product backed by fifty years of industrial power engineering. It is produced in a plant geared to modern demands and by machinery designed especially for the purpose. Dodge sheave design and precision manufacture insure maximum belt life and low maintenance.

Stock sizes of "D-V" Drives can be obtained on the immediate delivery basis. Modern production methods and unusual production facilities insure an adequate supply of stock drives at all times and non-stock drives can be furnished with minimum delay. "There is Added Value in the Name Dodge" both in quality and availability of product.

the DV drive

DODGE-TIMKEN BEARINGS

The only complete line of enclosed anti-friction industrial bearing units offering a type to meet practically every requirement of power transmission or machine application. In combination with "D-V" Drives they effect big economies in maintenance and insure continuous service.

DODGE MANUFACTURING CORPORATION

MISHAWAKA, INDIANA

THE FOUR DIVISIONS OF DODGE

POWER TRANSMISSION
Complete equipment for the transmission of power. Every type of pulley, hanger, pillow block, etc.

MATERIAL HANDLING
Every type of conveyor to handle any type of packaged or bulk material.

DODGE-TIMKEN BEARINGS
For power transmission and machine application. A type for every service.

SPECIAL MACHINERY
A manufacturing department for those who prefer to devote their attention to selling rather than making.

DODGE MANUFACTURING CORPORATION
Mishawaka, Indiana

Please send me the A-160 D-V Drive Data Book.

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*Position*_____

*Firm*_____

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DRILL MAINTENANCE
rests on selection

COCHISE
4-W
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STOPER

Put a No. 4-W Cochise Wet stoper on the job and cut drill maintenance costs out of your worries. This forged steel machine has remarkably high drilling capacity. It is compact, yet light in weight—and famous for its water tube design. Tube can be pulled out, cleaned, replaced, feed cylinder swung into position and nuts tightened on swing and hinge bolts in less than 5 minutes right at the stope or raise. Saves long trips to repair shop. Any wonder well known companies use this sturdy, powerful stoper with its infinitesimal maintenance cost?

Sold by

Cochise Rock Drill Mfg. Co.
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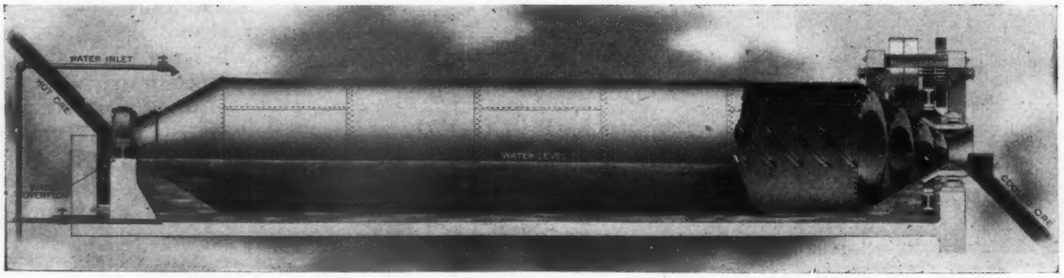
STEARNS-ROGER

The Baker Cooler

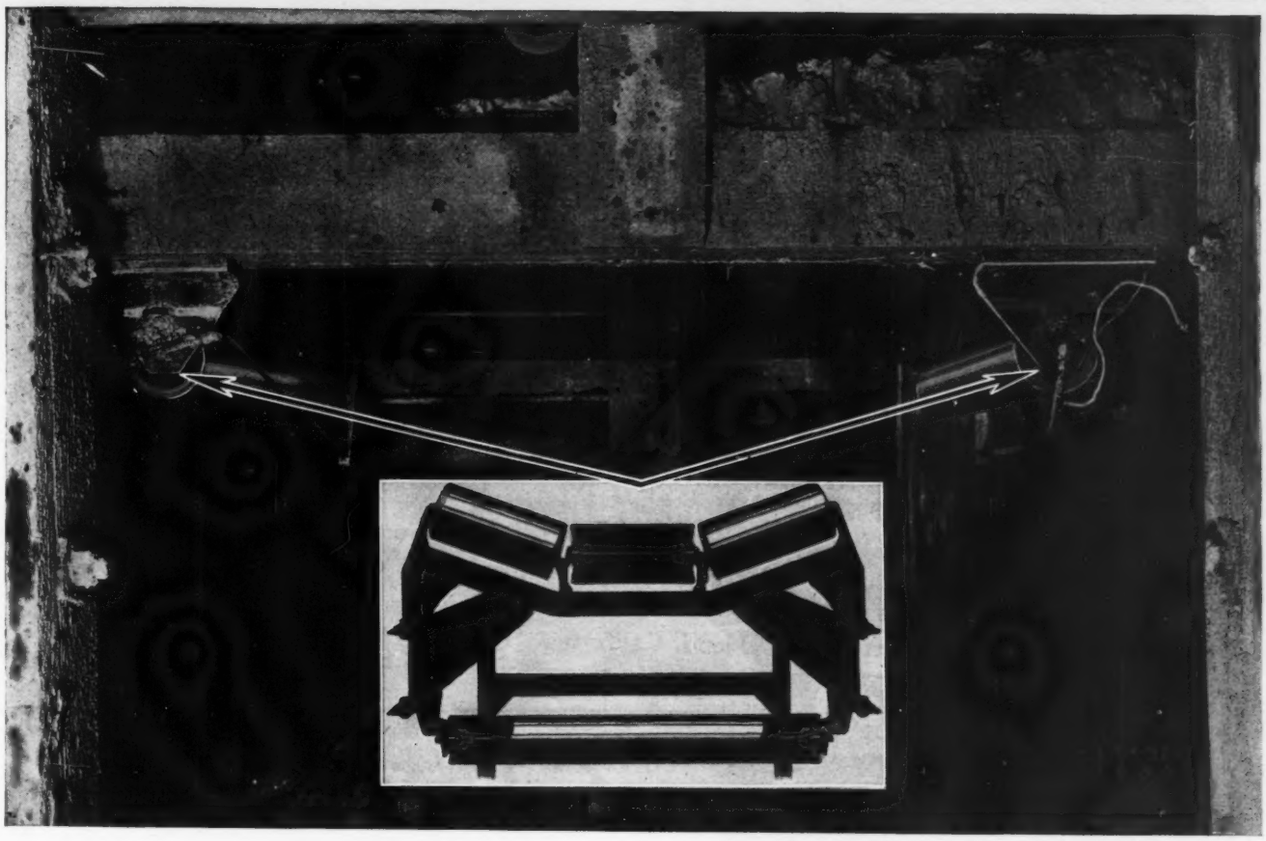
It Floats



Efficient Cooling of Roasted Ores.
No Dust Losses. No Loss of Head Room.
Low Power, Water and Maintenance Costs.

THE STEARNS-ROGER MFG. CO.
ENGINEERS CONTRACTORS — DENVER, COLO. — DESIGNERS MANUFACTURERS

HERE IS A REAL TEST FOR A BELT CONVEYOR IDLER



THIS picture shows the most severe and without doubt the wettest and sloppiest conveying problem in the metal mining industry. The conveyor used is a Link-Belt Anti-Friction Belt Conveyor. It is taking the discharge from an Oliver filter, the product resembling soup most of the time.

Until Link-Belt offered its Anti-Friction Idler to this industry, no idler would stand up under these abrasive conditions. The water saturated with particles of quartz, would seep in along the shaft and ruin any idler used.

After experimenting with many other types of idlers, it was found that Link-Belt Idlers stood the gaff. As a result, Link-Belt Idlers are standardized for both dry and wet work at this mine.

Send for a copy of Data Book No. 615 which covers the complete line.

LINK-BELT COMPANY 3943

Leading Manufacturers of Equipment for Handling Materials Mechanically and for the Positive Transmission of Power

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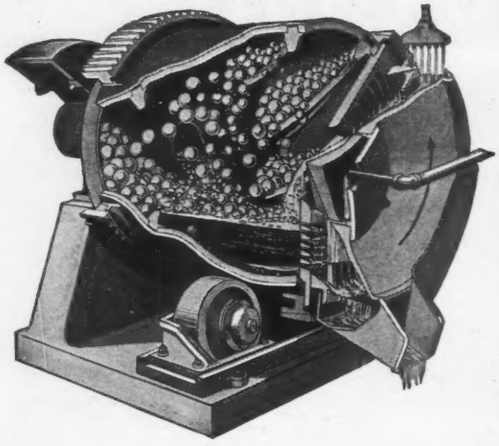
Atlanta, Baltimore, Birmingham, Boston, Buffalo, Cleveland, Dallas, Denver, Detroit, Grand Rapids, Kansas City, Mo., Los Angeles, Louisville, Milwaukee, Montreal, New Orleans, New York, Oakland, Pittsburgh, Portland, Ore., Seattle, St. Louis, Toronto, Vancouver, Wilkes-Barre

LINK-BELT ANTI-FRICTION BELT CONVEYORS

RIB-CONE RIFLE RIBS STOP SLIPPAGE!!



It's ball slippage we're talking about!

Slippage increases wear. There's *less* slippage in the Rib-Cone Mill, because the rugged *rifle ribs* positively *carry* the balls *up*—no sliding back—no skidding!

Rib-Cones run slowly—saving power, but they carry the balls *higher!* Falling farther, the balls hit harder—crush more ore!

Greater tonnage with less power

Rib-Cone balls stay round—no flat spots—they last longer!

And liners that last longer, too—when you save balls, you save the liners. The reverse rifle ribs save the grate, and circulates the ore. But that's another exclusive feature, described in Bulletin No. 105. Air mail will speed your copy on its way.

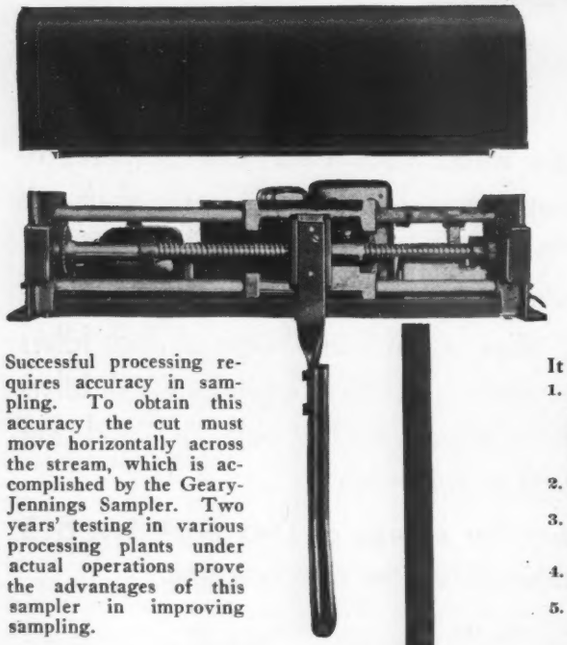
Screenless or Screening Rib-Cone Mills are available for your needs. There are many sizes, some sectionalized for transport to the mountains. One unyielding standard of quality—the best. Prices are moderate, and within reach. The smallest size is $575. We also build a complete series of mill equipment—ore feeders, Overstrom Universal concentrating tables, sectional steam boilers, fine crushing rock breakers, thickeners and classifiers—

Ore-testing **Plant design** **Construction**

STRAUB MFG. CO.

507 Chestnut St., Oakland, California

GEARY-JENNINGS SAMPLER



Cuts Horizontally Across the Stream

Successful processing requires accuracy in sampling. To obtain this accuracy the cut must move horizontally across the stream, which is accomplished by the Geary-Jennings Sampler. Two years' testing in various processing plants under actual operations prove the advantages of this sampler in improving sampling.

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1. **CORRECT SAMPLING REQUIREMENTS ARE COMPLETELY FULFILLED** by the Geary-Jennings Sampler. (a) The mechanism operates at regular time intervals, the duration of which may be quickly and easily varied to suit demands. (b) The cutter does not swing in an arc but moves across the pulp stream in a straight line and (c) at a uniform rate of speed.
2. **A DUST-PROOF MOISTURE-PROOF HOUSING** encloses the entire mechanism.
3. **TAMPERING WITH THE SAMPLER IS IMPOSSIBLE.** The housing is arranged to be padlocked in place, rendering all parts of the machine inaccessible to unauthorized persons.
4. **LUBRICATION IS REQUIRED NOT OFTENER THAN ONCE EVERY TWO OR THREE MONTHS.**
5. **THE SAMPLING INTERVAL MAY BE VARIED TO SUIT REQUIREMENTS.** A pointer and dial on the adjustable timing switch permits variation of sampling period to any interval between two seconds and thirty-six minutes.
6. **ANY NUMBER OF SAMPLERS MAY BE OPERATED SIMULTANEOUSLY** by a master timing switch, which may be located under one of the sampler housings or outside the housing in any location desired.
7. **ELECTRICAL EQUIPMENT IS STANDARD** thruout the machine. No special devices are used.
8. **HEADROOM AND SPACE REQUIREMENTS ARE SMALL.**
9. **THE GEARY-JENNINGS SAMPLER IS BUILT TO LAST** and give service at minimum cost over a long period of time. There are no cams or delicate wearing parts. Sturdiness is built into the machine.

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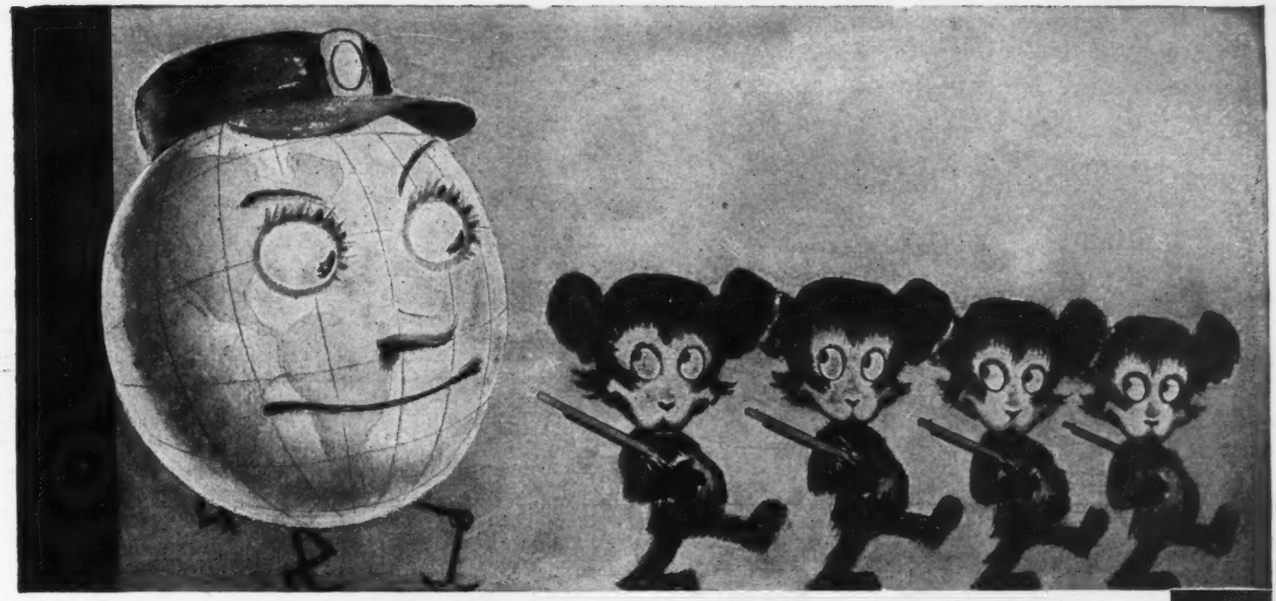

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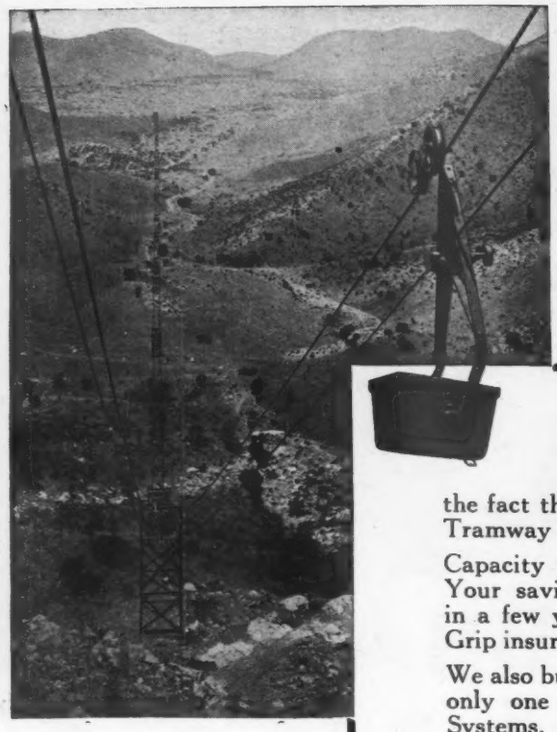

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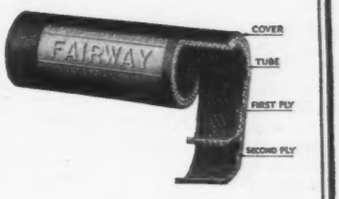

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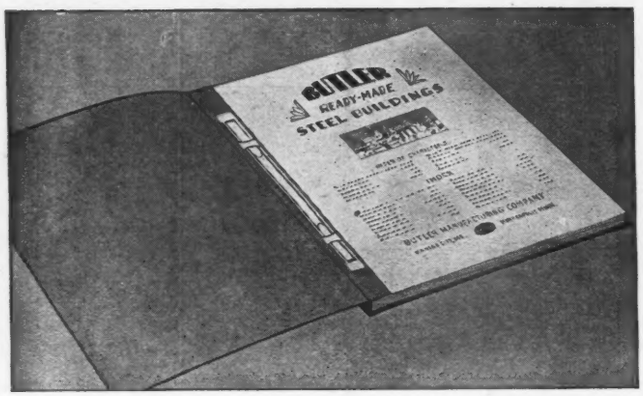

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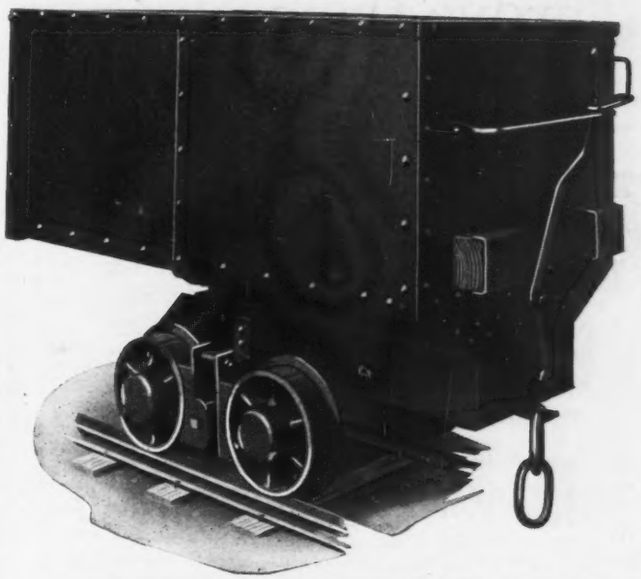

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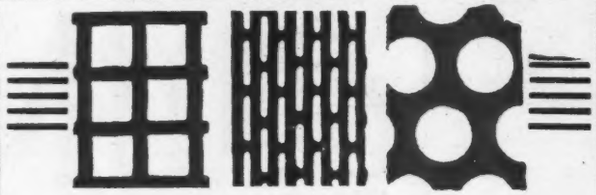

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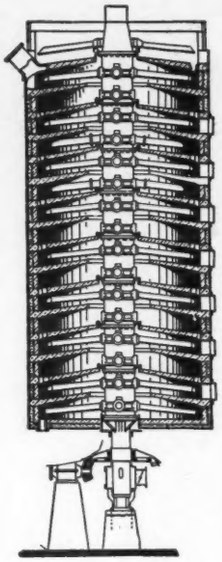

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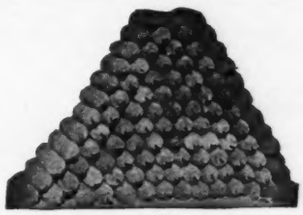

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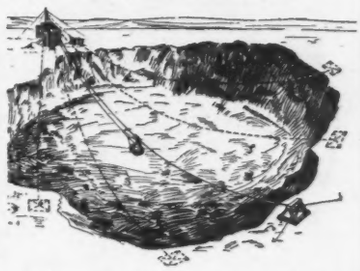

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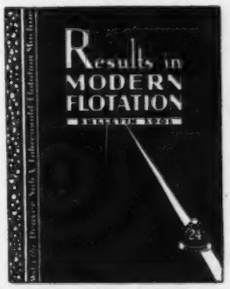

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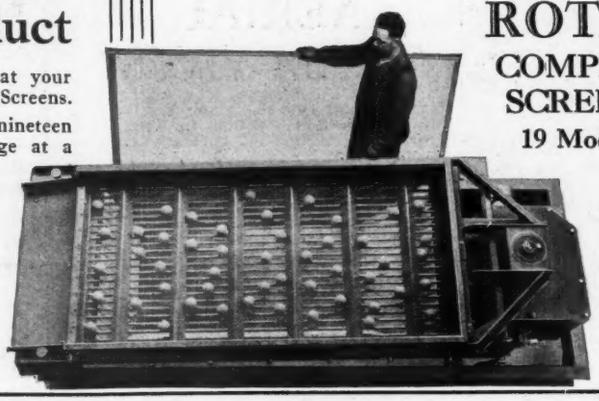

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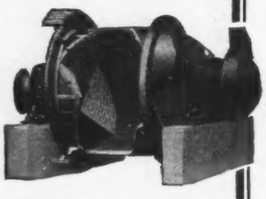

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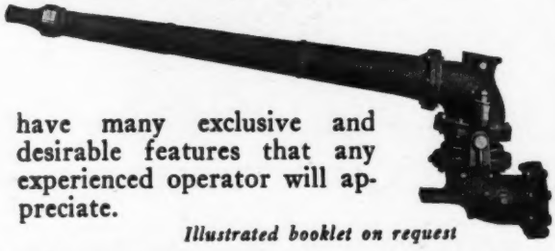

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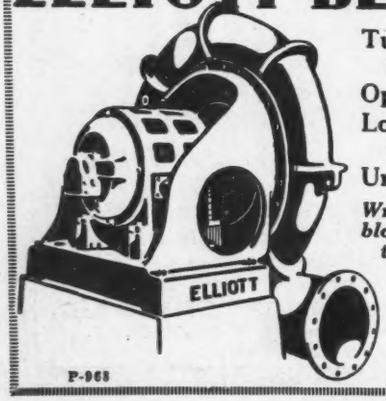

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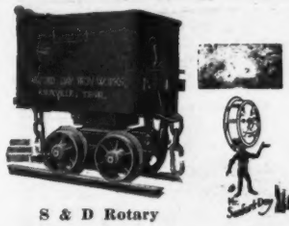

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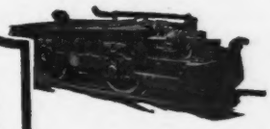

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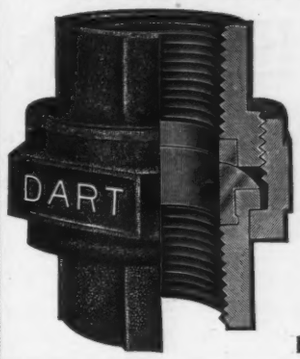

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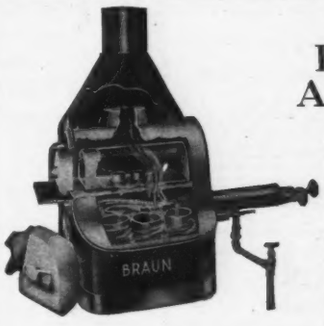

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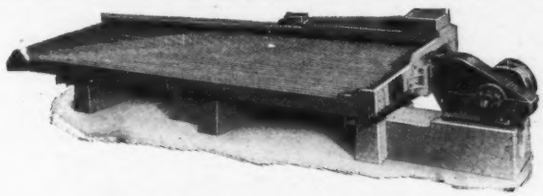

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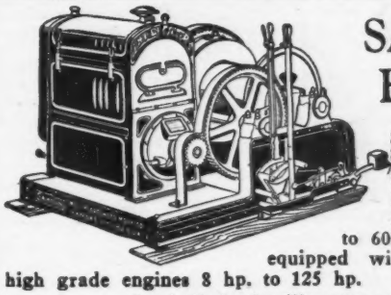

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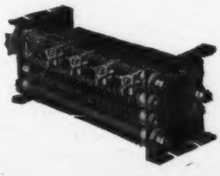

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(Continued on the opposite page)

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Additional Property For Sale ads on page 53

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1—Cutler-Hammer Magnetic Pulley, 12x18 in., with Northwestern D.C. ½ kw., 110 volt Generator.
1—Buchanan, type D, 12x4-ft. overall, 18-in. belt.
1—Dings 12x16-in., 110 volt.

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Ball Mills
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14x14-ft., 12x12-ft., 6x6-ft. Rotary Filters.
Jigs, Tables, Screens, Air Separators, Classifiers and Thickeners.

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1—16 ft. Dorr **Thickener**—NEVER USED.
3—**Oliver Filters,** 6 ft.x 4 ft., 3 ft. x 4 ft., 3 ft. x 2 ft.
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1—Ingersoll-Rand Type XCB Imperial two-stage Compressor, size 18x10½x14, capacity 1000 cu.ft., complete with 5 step unloader, short belt drive and 160 hp. synchronous motor.
1—Ingersoll-Rand Portable Compressor Type 10, capacity 210 cu.ft.
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HOISTS

1—75 hp. Wellman-Seaver-Morgan Single Drum Mine Hoist 7500 pound rope pull 350 ft. per minute, complete with motor, reversing control and resistance.
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1—Fairbanks-Morse 6 hp. Gas Engine Single Drum Hoist complete.

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1—8-ft. x 30-in. Hardinge Conical Ball Mill complete with new Liners.
1—64½ Marcy Ball Mill complete with Liners.
1—5-ft. x 5-ft. Colorado Grate Discharge Type Ball Mill complete with new Liners.
1—6-ft. x 22-in. New Conical Ball Mill.
1—4½-ft.x16-in. Hardinge Conical Pebble Mill.

CRUSHERS AND ROLLS

1—No. 8 Allis-Chalmers Style K Gyratory Crusher.
2—No. 9 Allis-Chalmers Style K Gyratory Crushers
1—No. 3 Allis-Chalmers Style D Gyratory Crusher.
1—9 x 15 Blake Type Jaw Crusher.
1—10 x 16 Universal Jaw Crusher.
1—11x15 Traylor Dodge Type Jaw Crusher.
2—Sets 30-in. x 10-in. Allis-Chalmers Crushing Rolls.
2—Sets 20x12-in. Davis Crushing Rolls.
2—Sets Worthington size 72-in. x 20-in. Crushing Rolls.

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2—G.E. Synchronous Motor Generator Sets: mounted on common base, 3 bearing; Motors type A.T.I. kva. 720, Form C, 60 cycles, 720 rpm., 367 amperes, 2200 volts, horsepower output 1750; generators are direct current type MCF-8-1250 Form L, 5000 amperes 720 r.p.m., 250 volts: Sets are complete with switchboard panels.
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1—Model "C" Dorr Simplex Classifier, size 2-ft. 6-in.x14-ft. 8-in.
1—Model "C" Dorr Duplex Classifier, size 4-ft. 6-in. x 14-ft. 8-in.
1—Model "C" Heavy Duty Duplex Classifier, size 6-ft. x 20-ft.

FILTERS

1—4-ft. x 6-ft. Oliver Continuous Filter with vacuum equipment.
1—6-ft. x 6-ft. Oliver Cintinuous Filter with vacuum equipment.
1—11-ft. 6 in. x 6-ft. Oliver Continuous Filter with vacuum equipment.
1—6-ft. x 3 Disc American Filter with vacuum equipment.
1—4-ft. x 1 Disc American Filter with vacuum equipment.

Electric Motors, Thickeners, Locomotives, Transformers, etc., etc.

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1—Yuba Mfg. 18-in. **Centrifugal Pump** direct connected to 150 hp. Westinghouse Motor, 2,200 v., 3 ph., 60 cy., cap. 9,000 gal. per min. at 33 ft. head.
Both of above equipped with Deane 6x12 Priming Pump complete with 5 hp. Motors.
3—Miles No. 6 **Power Line** complete with cross arms, insulators, switches, etc. all new.
3—18-ton Vulcan **Locomotives,** 36 in. gauge, steam.
1—20-ton American **Locomotive,** 36 in. gauge, steam.
12—**Westerns,** 4 yd., dbl.side dump, 36 in.ga.

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10—8-ft.x30-in., 8x22, 7x48, 7x36, 6x48. 6x22 **Hardinge Ball Mills.**
4—8x8-ft., 8x5-ft. **Bonnot Ball Mills.**
9—3x12-ft., 5x22-ft. **Tube Mills,** iron lined.
1—5x12-ft. heavy duty, **Unlined Tube Mill.**
1—5-ft. 6-in.x6-ft. **Unused Rod MILL.**
2—2-ft. 6-in.x4-ft. **Ball Mills.**

All sizes of Gyratory, Jaw, Roll Crushers; Ball, Tube and Hardinge Mills; Air Separators; Rotary Kilns and Dryers; Oliver, Sweetland and other Filters.

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Send for our latest list No. 10

Consolidated Products Co., Inc.
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Continued from page 51

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WANTED—A Gold property.

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30-ft. vein, Hundred Thousand Yards $6.00. Ore in sight. Shaft 140 ft. deep, no foot wall. Will stand thorough investigation.

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1—Williams No. 1 Universal Fine Grinder; capacity 4 to 5 tons per hour.
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1—American Ball Mill, 4-ft. diameter by 8-ft. long; steel liners; belt and pulley drive.
1—Standard Ball Mill, 4-ft. diameter by 3-ft. long; steel liners; complete with drive.
1—Allis-Chalmers Tube Mill, 4-ft.6-in. diameter by 12-ft. long; silex lining; practically new condition.
1—F. J. Smidth Tube Mill, 4-ft. diameter by 16-ft. long; silex lining; complete with drive.
1—Gardner No. 2B Crusher.

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6—14-in. Worthington Centrifugal Pumps, 8500 g.p.m.; 152-ft. head; motor driven.
2—14-in. Allis-Chalmers; Centrifugal Pumps, 6500 g.p.m.; 150-ft. head; turbine driven.
6—16-in. Allis-Chalmers Centrifugal Pumps, 8500 g.p.m.; 90-ft. head; turbine driven.
2—5-in. Goulds Centrifugal Pumps, 800 g.p.m.; 115-ft. head; motor driven.
1—8-in. Hill Tripp Centrifugal Pump, 1200 g.p.m., 120-ft. head; motor driven.

NASHVILLE INDUSTRIAL CORPORATION
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Leschen 12,000 ft. Tramway; complete.
100 hp. and 150 hp. Oil Engines; with or without Generators.
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5—Dorr Thickeners, 28 x 12-ft.
5—Dorr Thickeners, 28 x 10-ft.
Oliver Filter, 8 x 8.
Oliver Filter, 3 x 2.
4-Ton General Electric Loco., Trolley Type, 24-in. Ga., with Cars.
2—Worthington 7 x 12 Tube Mills; New.
150-Ton Cyanide Plant; complete.
75 hp. Hendy Single Drum Electric Mine Hoist.

Send for our Bulletin, which gives complete list of good used Mine and Mill Machinery we have in stock.

U. S. Machinery & Steel Co.
750 Folsom St., San Francisco

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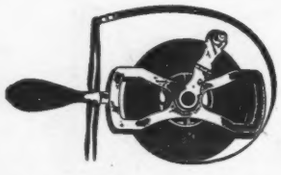

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Automatic Feeder Weigher, Conveyor for automatic weighing of Crushed, Granulated, Pulverized Materials

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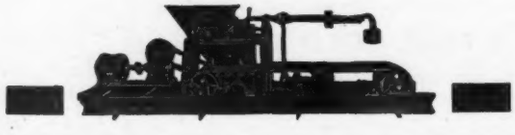
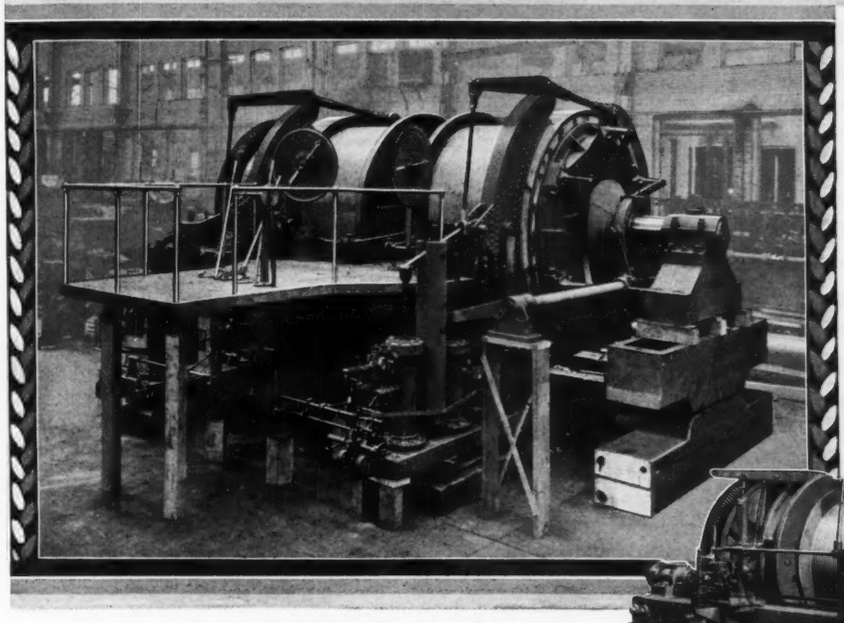
Schaffer Poidometer Co.
Pittsburgh, Pa.

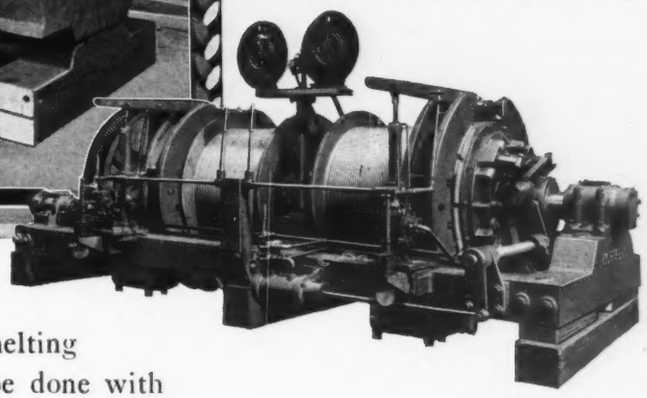


HUDSON BAY SELECTS NORDBERG HOISTS

DEVELOPING—MEN AND MATERIAL—ORE



The small double drum developing hoist, shown below, has 4-foot diameter drums with 36-inch face, grooved to wind 2,000 feet of $\frac{7}{8}$-inch rope. One drum is keyed —the other clutched.



All the hoisting at the new Flin Flon Mine of the Hudson Bay Mining and Smelting Company in Northern Manitoba is to be done with three Nordberg Hoists. These modern Nordberg Hoists, as in many other of the World's larger mining projects, were chosen as the best solution of its hoisting problems.

Specifications of Man and Material Hoist

Steel Plate Drums—8′ diameter 46″ face.

Rope Speed—1200 feet per minute.

2150 feet of $1\frac{1}{2}$ inch rope.

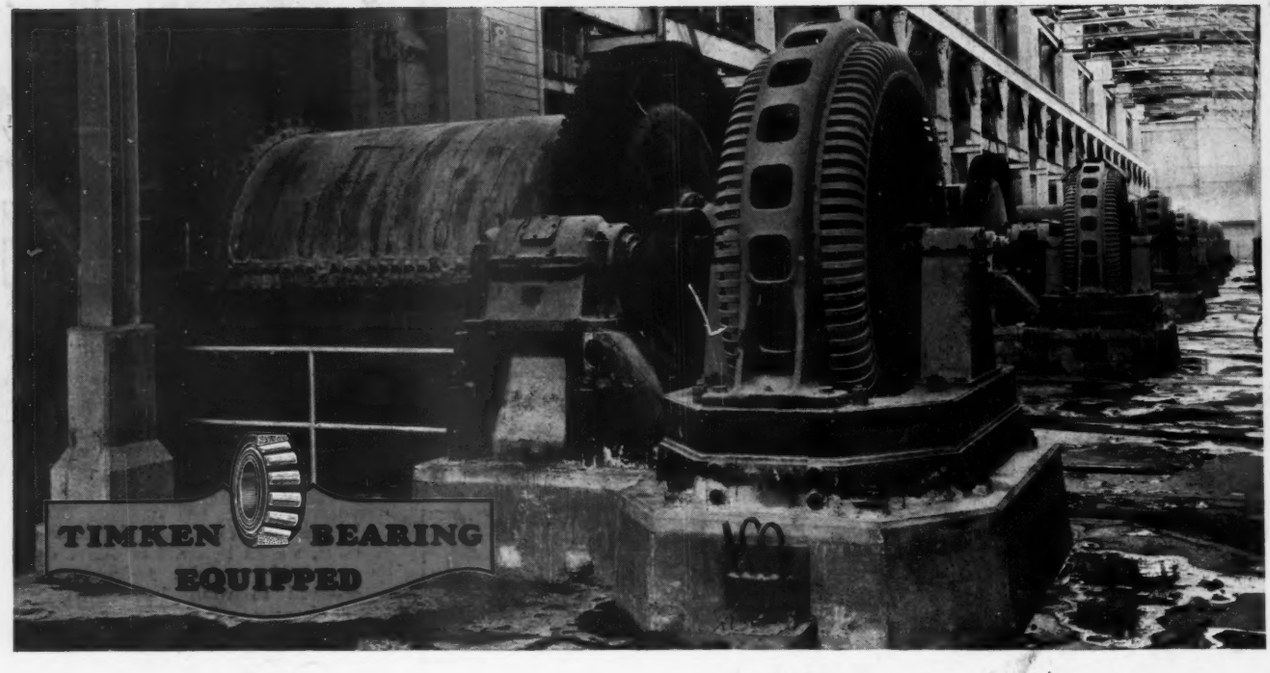
Total Load 24,650 pounds—Counterweight 8,000 pounds

Brakes 9′ diameter—Clutch 9′ diameter.

Motor 250 horsepower.

Years of experience of Nordberg Engineers in hoist design and construction is available to hoist users

NORDBERG MFG. CO. MILWAUKEE WISCONSIN



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